THE SOCIOECONOMIC IMPACTS OF SYNTHETIC FUELS

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY DEVELOPMENT AND APPLICATIONS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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THE SOCIOECONOMIC IMPACTS OF SYNTHETIC FUELS

WEDNESDAY, APRIL 28, 1982

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS,
Washington, D.C.

The subcommittee met, pursuant to call, in room 2318, Rayburn House Office Building, at 9:35 a.m., Hon. Don Fuqua (chairman of the subcommittee) presiding.

Mr. FUQUA. This hearing is the third in a continuing series involving the developing synthetic fuels industry. Last July we heard from the chairman of the U.S. Synthetic Fuels Corporation and from financial and technical witnesses on the status of the industry and on anticipated activity. Later we conducted a hearing on the environment research and development necessary to meet current regulations and to define other health, safety, and social consequences of synfuels production.

Several of our witnesses have alluded to nontechnical issues which are closely allied with technical development. Today we want to address those socioeconomic aspects of the synthetic fuels industry. The construction and operation of a synfuels production plant could seriously strain the cultural and social infrastructure of the area where the plant is located.

It is very important to recognize that the development of the synthetic fuels industry is dependent on the people who will design, construct, and operate the facilities. Those people, in turn, must rely on government, particularly local, to maintain standards of law and order, education, and general well-being.

Accomplishing these goals will require a close working relationship between individual synfuel projects and their local and regional governments. It is easy to appreciate the complexity of such an undertaking. However, the country does not have the luxury of unlimited time to develop the synthetic fuels industry in an evolutionary manner.

The purpose of Federal assistance for synthetic fuels is to demonstrate as quickly as possible that we can convert the Nation's vast natural resources to more usable energy forms.

Our witnesses today are all closely involved with various aspects of synthetic fuels industry development. Two of them work for oil shale extraction projects that are being assisted by the Synthetic Fuels Corporation. The Synthetic Fuels Corporation is evaluating detailed proposals of an additional five projects.

We have two witnesses from Kentucky, a State vigorously promoting synthetic fuels development. Colorado has probably been evaluating the impacts of developing synthetic fuels longer than any other State and one of those participants is here today.

Our first panel consists of Allen Randle from Union Oil, Dr. Robert King from TOSCO, and Russell Sights, city manager of Henderson, Ky.

Without objection we shall include in the record at this point the opening statement by Mrs. Bouquard.

[The prepared statement of Mrs. Bouquard follows:]

HON. MARILYN L. BOUGUARD
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
SOCIO-ECONOMIC IMPACTS OF SYNTHETIC FUELS
APRIL 28, 1982

Mr. Chairman. I believe this is a timely hearing and I trust it is indicative of the fact that this Committee still supports a strong synthetic fuels development program. As you know, the Synthetic Fuels Corporation has narrowed the field of projects for its first round of awards down to just 5. Reasonable men may differ on the relative merits of these projects and others which were reviewed by the SFC Board and its staff. Nevertheless, I hope that the Corporation will now move to accelerate negotiations and make awards while beginning activities pursuant to the next round of solicitations. If this country's program falters because of a temporary oil glut and the related price decrease in imported oil, then we will again be taking the risk of losing precious time, just as we did in the mid-70s after the Arab oil embargo.

I am very pleased that we have State and city representatives here this morning and others, including industry and professional consultants, to inform us on the subject of the socio-economic impacts of synfuels development. I think it is most important to understand the experiences thus far in planning to mitigate the potential negative impacts of these large projects. However, I would caution the

Committee that all this concern, all this planning may ultimately turn out to be "much ado about nothing" unless this Committee and this Congress can see to it that projects are awarded financial assistance by the SFC and go ahead to become operational sometime in this decade.

Mr. Chairman, finally, I hope that the Department of Energy will engage in an extensive effort to capture the "lessons learned" in its synthetic fuels activities and catalogue this data in a way that it can be most useful to the Synthetic Fuels Corporation. I am most concerned that this Committee should continue to insist on the DOE being the major technical arm of the SFC so that the Federal government itself can provide a central data base for building these plants. I would also suggest that the Committee should take a page from the 96th Congress and revive the concept of the synthetic fuels program as truly aiming at the creation of a national security reserve of petroleum liquids and substitutes. Thank you.

STATEMENTS OF ALLEN C. RANDLE, VICE PRESIDENT, OIL SHALE OPERATION, UNION OIL CO. OF CALIFORNIA, GRAND JUNCTION, COLO.; ROBERT R. KING, PH. D., MANAGER, COMMUNITY DEVELOPMENT, TOSCO CORP., BOULDER, COLO.; RUSSELL R. SIGHTS, MANAGER, CITY OF HENDERSON, HENDERSON, KY.

[The biographical sketch of Mr. Randle follows:]

ALLEN C. RANDLE

Born in Trinidad, Colorado in 1943, Allen Randle attended the Colorado School of Mines obtaining a degree in Petroleum Refining Engineering in 1965. He joined Union Oil Company of California in July of that year. During his fifteen years with Union Oil Company, he has worked at Union's refineries in Chicago, San Francisco and Los Angeles. He has worked in both engineering and operations capacities and at various times has supervised refinery process engineering, refinery planning and refinery production departments. Before moving to Grand Junction, he was superintendent of the hydro-treating department at San Francisco Refinery. In November, 1978 he joined Union Oils, oil shale operations as Manager of Retort Operations. In April of 1980 he was promoted to Vice President, Oil Shale Operations.

Allen and his wife Joan have two sons.

Mr. RANDLE. Thank you, Mr. Chairman.

I appreciate this opportunity to appear before you today and present the efforts that the Union Oil Co. has made in addressing the social and economic impacts of our project in northwestern Colorado.

I am vice president for oil shale operations for Union Oil Co. I am in charge of the planning and the operation of our Parachute Creek shale oil program. I have brought with me today several slides which show our activities. Without further ado I will go through those.

This slide indicates our property location in Colorado. The Piceance Basin is in the northwestern part of the State.

Mr. FUQUA. How far north are you from Grand Junction?

Mr. RANDLE. About 50 miles, sir. Our property is shown in the salmon color on the right.

This next slide tilts the property and locates our primary activities. They consist of a mine retort, and an upgrading plant to produce premium crude oil. On the far south end of the property the town of Parachute is shown.

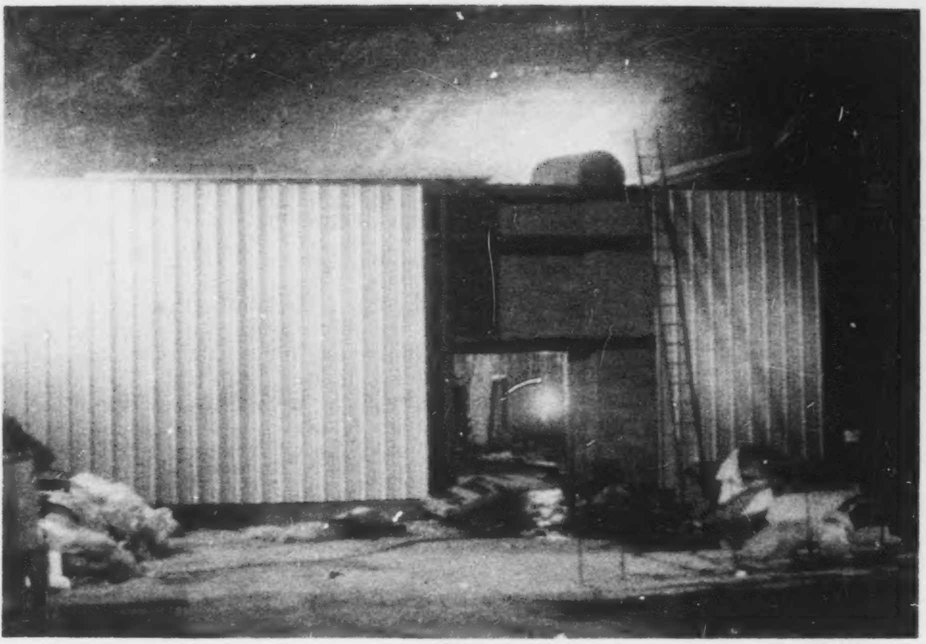


FIGURE 1

This is the underground mine facilities area. (Figure 1.) Construction mining was completed in January. Currently, construction workers are erecting buildings underground, including a miner change room, mine office, and a warehouse. Conventional room and pillar mining techniques are being used. Shale crushing and storage will also be done underground.

This map shows the areas that have now been mined. Approximately 2½ miles have been completed, with 600,000 tons of material removed.

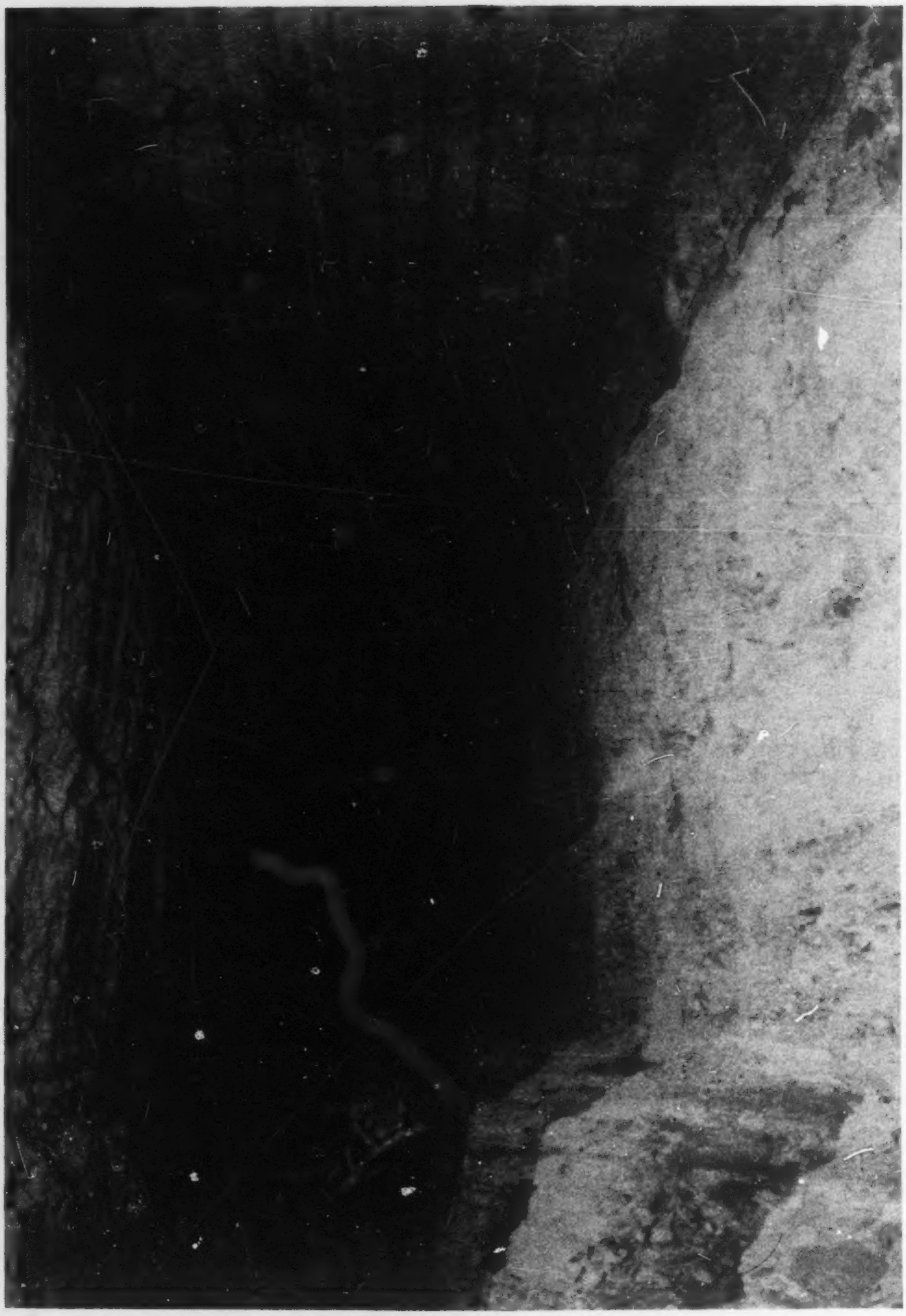


FIGURE 2

This is a picture inside the mine in our shale storage gallery. That is an area in the mine which is about 110 feet in height, about 50-feet wide and 1,200-feet long. (Figure 2.)

This slide shows the office we are building inside the mine area.

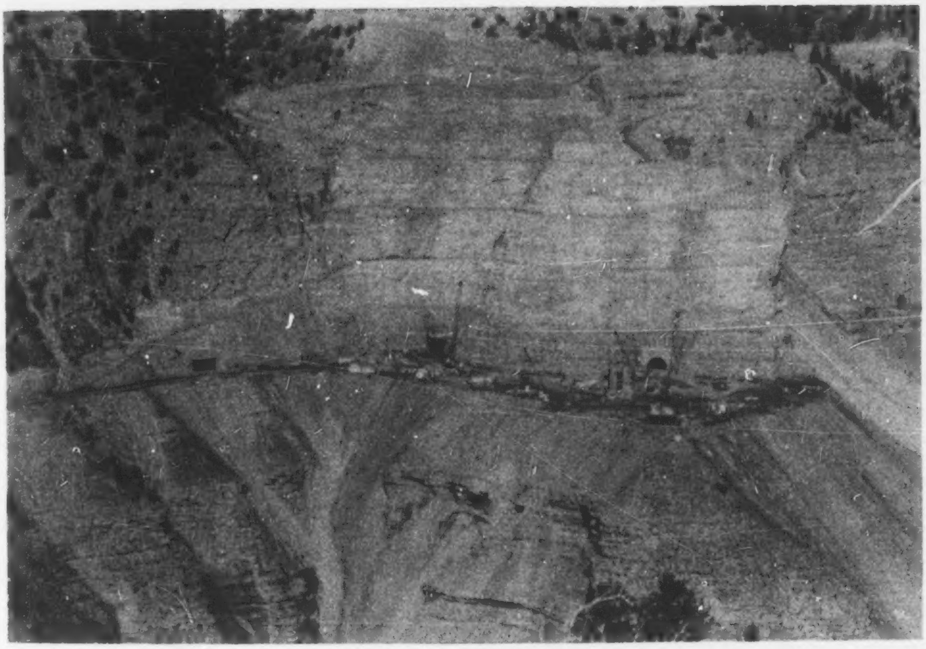


FIGURE 3

Here is a picture of the retort which is being built at the mine mouth. You can see three mine openings in the back slope behind the retort plant. (Figure 3.)

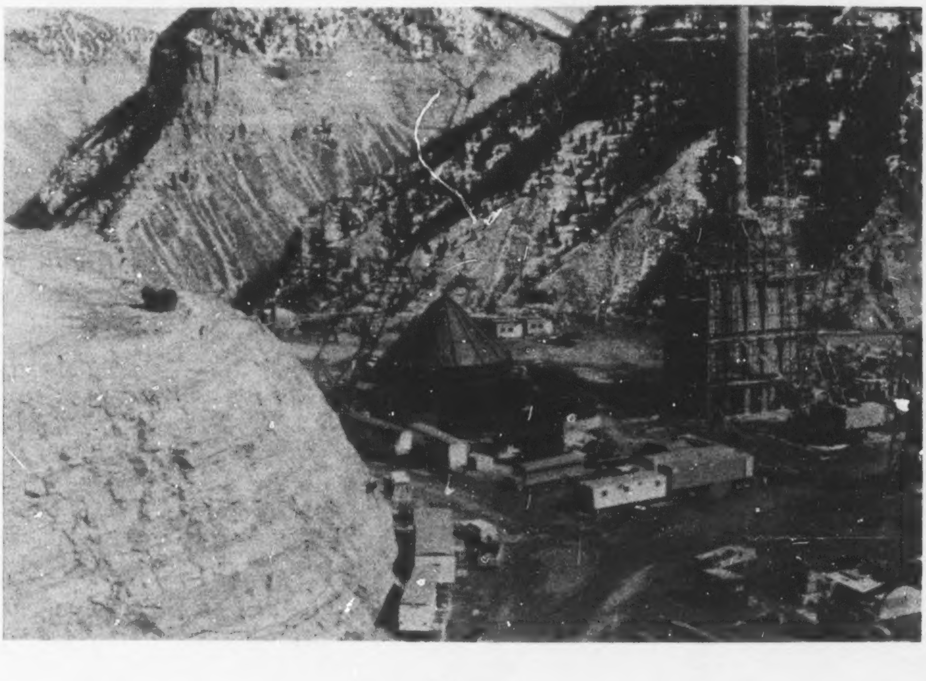


FIGURE 4

This is a general view of the construction in its current state on that bench. The large gray structure is a process furnace; the retort itself is under construction just to the left of that furnace. (Figure 4.)

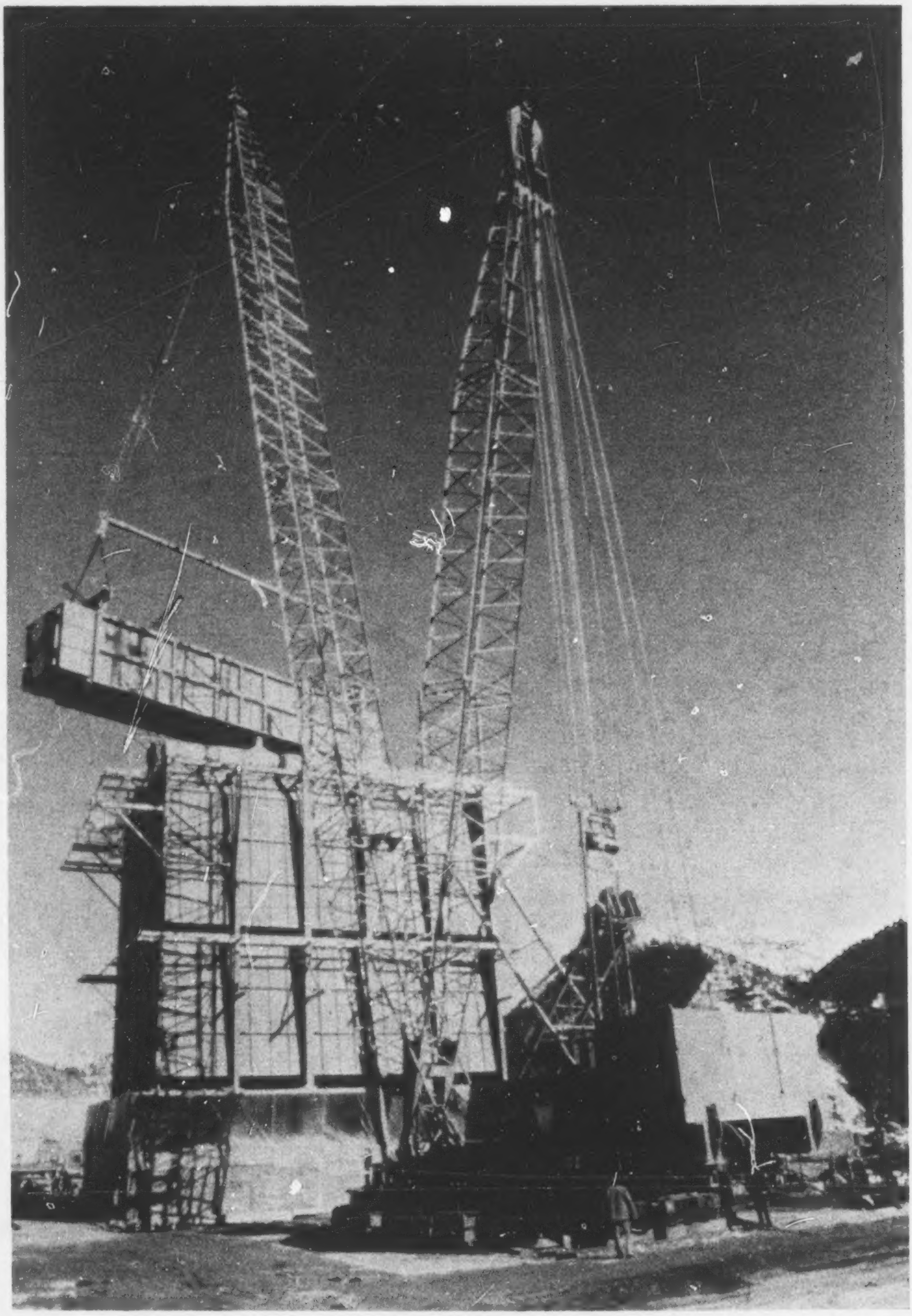


FIGURE 5

This slide shows another view of that furnace. (Figure 5.)

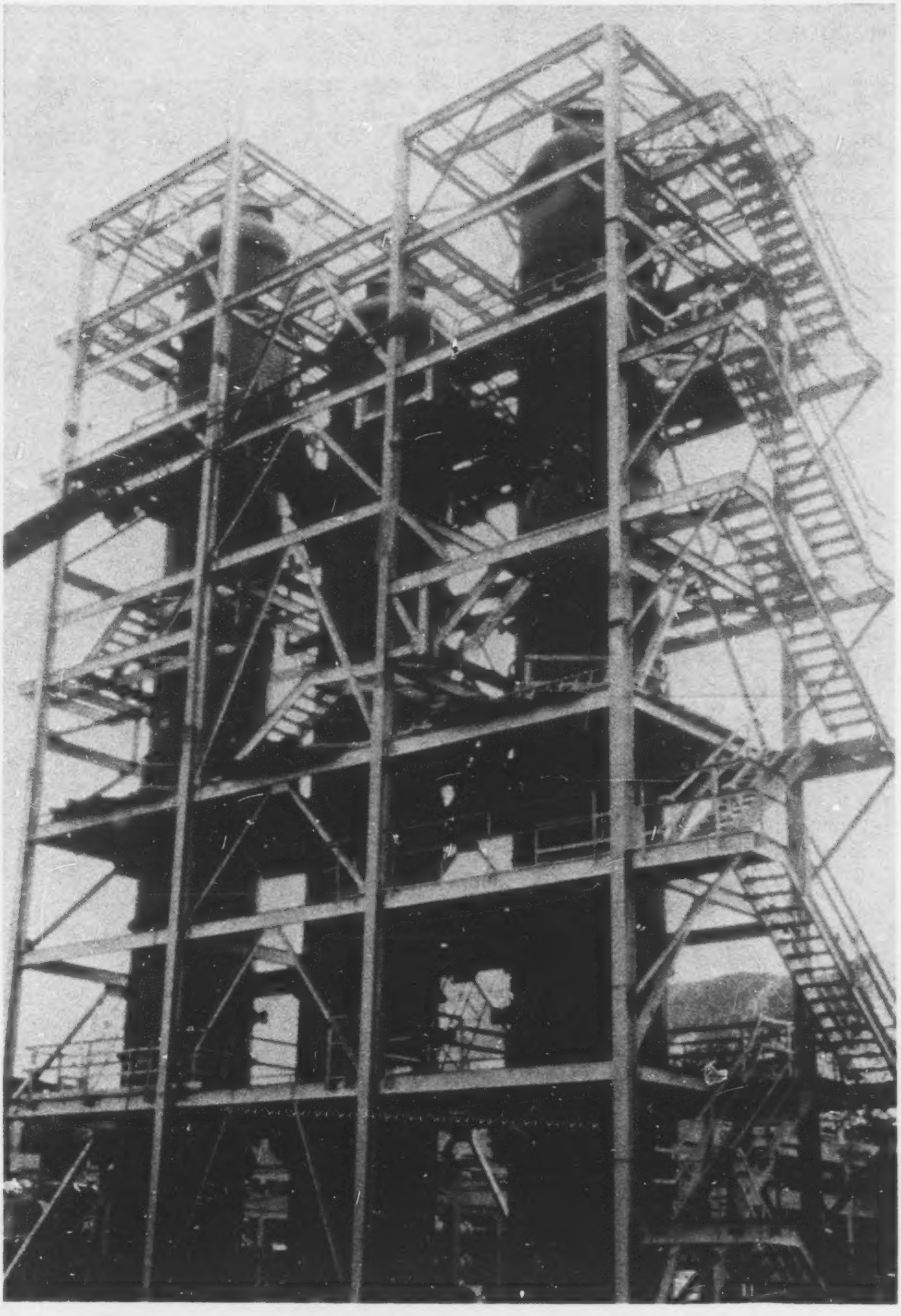


FIGURE 6

This slide shows the large reactor vessels that are the heart of the process of upgrading the crude shale oil into a premium crude oil. (Figure 6.)

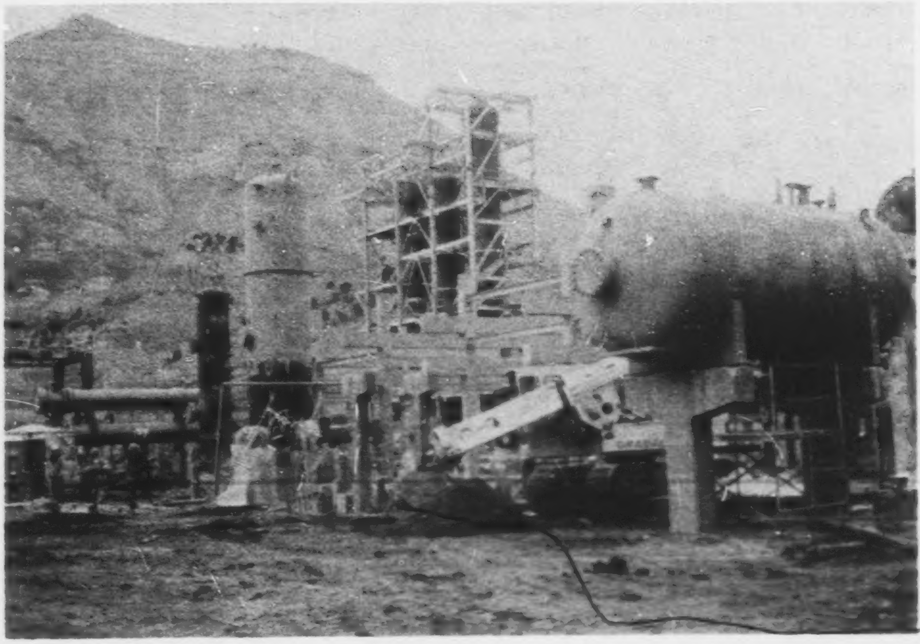


FIGURE 7

Another view of the upgrading facility is shown in this slide. (Figure 7.)

FIGURE 8

As we started to develop this project we realized that one of the primary needs in western Colorado was going to be housing. These next few slides show the effort that we have taken to provide that housing. We have supplied 192 apartment units in the town of Parachute, and this is a picture of those units. (Figure 8.)

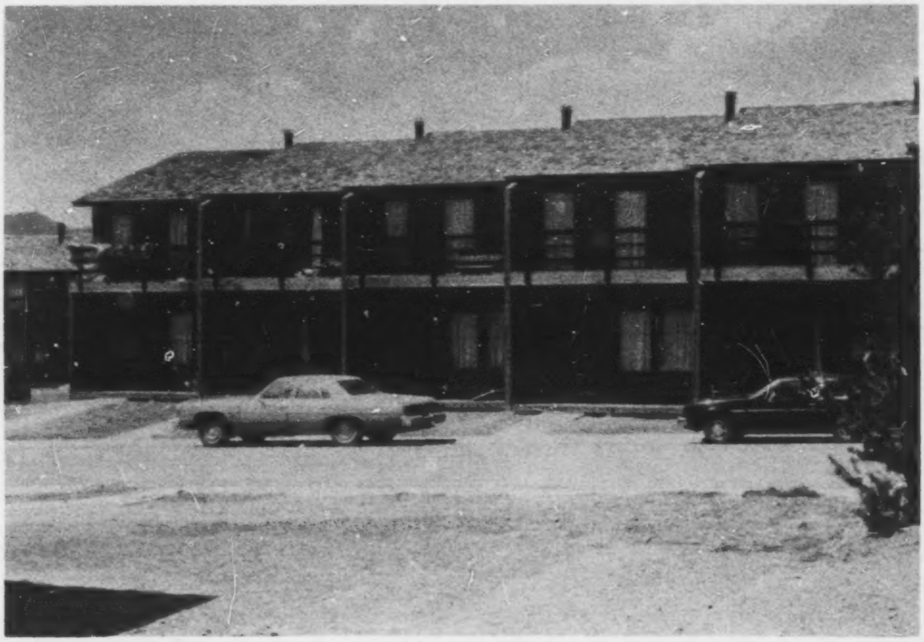


FIGURE 9

Here is another picture of the same apartments. There are eight buildings arranged in a circular fashion. Common recreation facilities are provided in the interior of the circle. Automobile traffic is restricted to the outside of the circle. (Figure 9.)

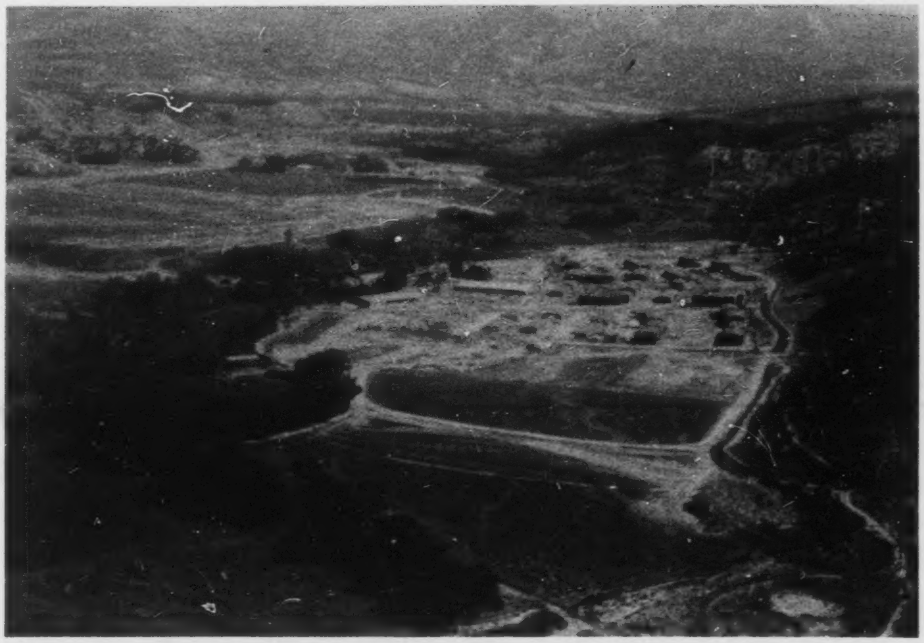


Figure 10

We have also provided a trailer park where 40 trailers are located. The property has been plotted for single-family homes; when the trailers are no longer needed they can be removed and homes can be built. (Figure 10.)

Figure 11

In the town of Rifle we have built or leased another 202 apartment units. We have provided a total of 434 living units for employees on family status. (Figure 11.)

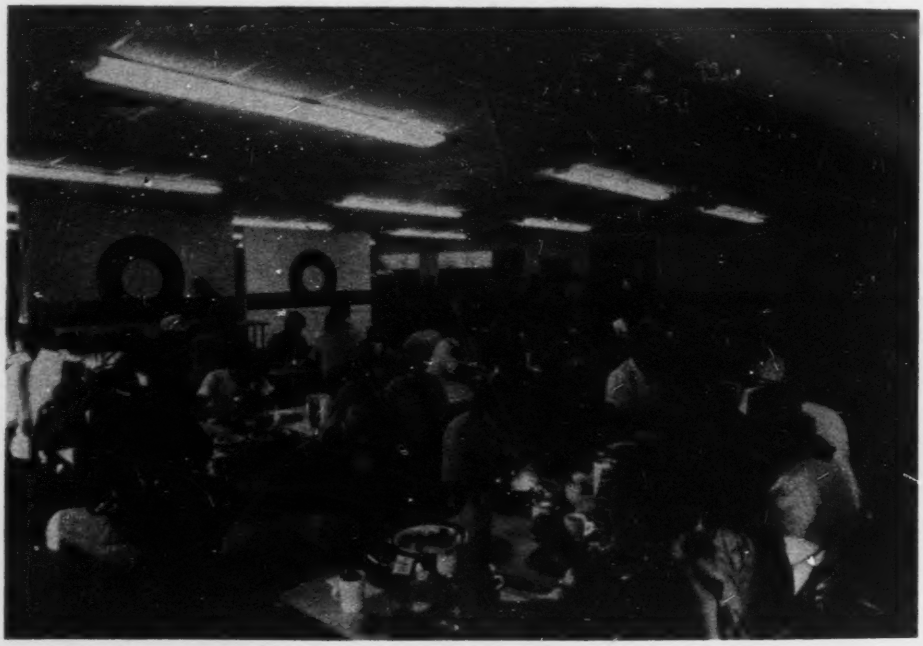


FIGURE 12

We recognized that a significant number of people who work on projects like ours live as singles. Therefore we have built a complex to house single-status workers. This slide shows that complex. There are presently 750 living units available there. We are currently expanding the complex to a total of 918 units.

This is a picture of the dining hall. (Figure 12.)

FIGURE 13

This slide shows some of the recreation facilities available in the camp. (Figure 13.)

This is one of the rooms. Each room with private bath accomodates one person.

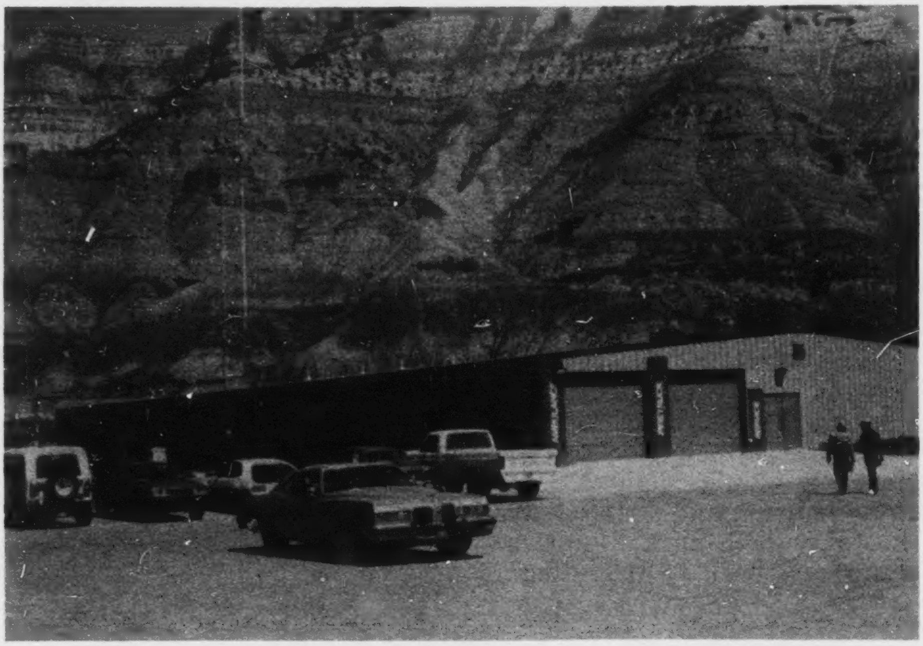


FIGURE 14

This slide shows the emergency equipment provided at the camp; we have a fire truck and ambulance on site. (Figure 14.)

That briefly summarizes the housing that has been provided. I might add that the work force was approximately 1,500 or 1,600 people late last fall it held at that level through the winter. We expect employment to start increasing again this spring and peak this summer at about 2,400 people. The work force will start to decline this fall until completion of the project in 1983.

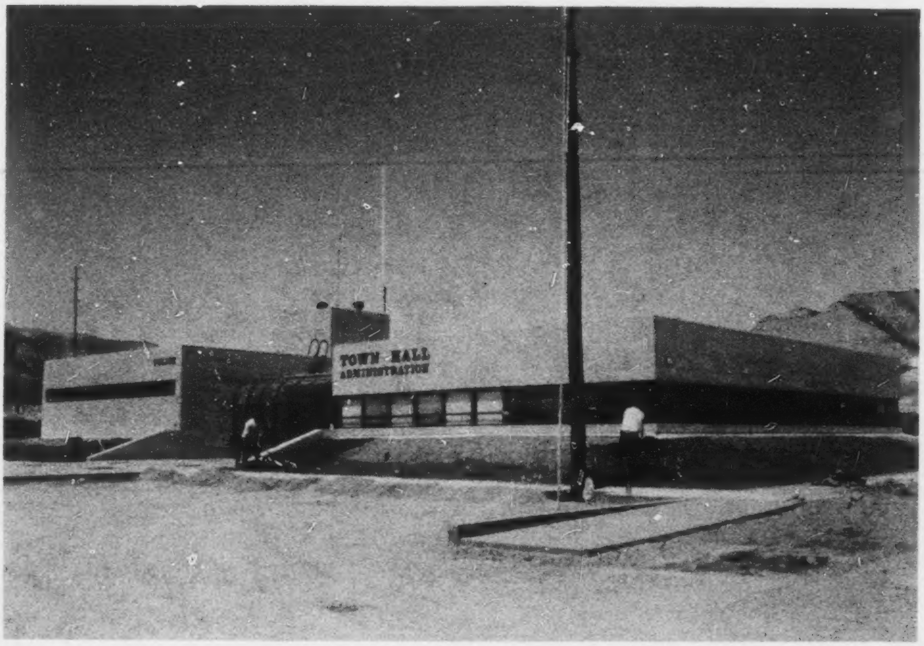


FIGURE 15

In the town of Parachute, Union has provided more than $370,000 in direct assistance to the community. The grants are to cover the increased costs of providing services to the area. Funds have been provided for administrative services, emergency medical services and law enforcement. The town administration and police department recently moved into a new town hall complex. (Figure 15.) Union made a $136,000 grant to the town to purchase the property where the town hall was built. Union has also provided $3,000 for architectural services in designing the new fire hall and also granted $72,000 for a new fire truck for the Grand Valley Fire District.

In addition to direct grants to Parachute, we prepaid $600,000 in water and sewer tap fees so the town would have the money available early on. We paid $250,000 in annexation fees for our Parachute housing and donated adjoining property valued at $150,000 to the town for a park. Our total contributions to the town of Parachute have been $1.37 million.

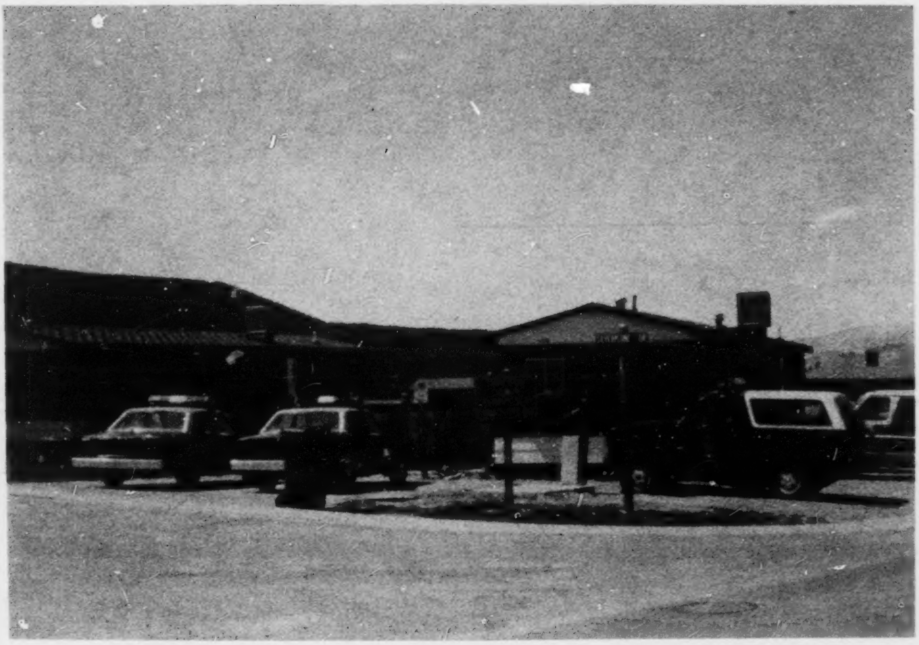


Figure 16

In Garfield County, the county in which our project is located we have provided money so that the county can increase its law enforcement services. We have made grants to the county to allow them to have five sheriff's deputies and equip those deputies with cars, radios, and so forth. (Figure 16.)

We have also made grants to allow the county to make a solid waste disposal study and to increase their human services budget so that these needed services can be expanded. There has been a total of $300,000 granted to the county for those activities.

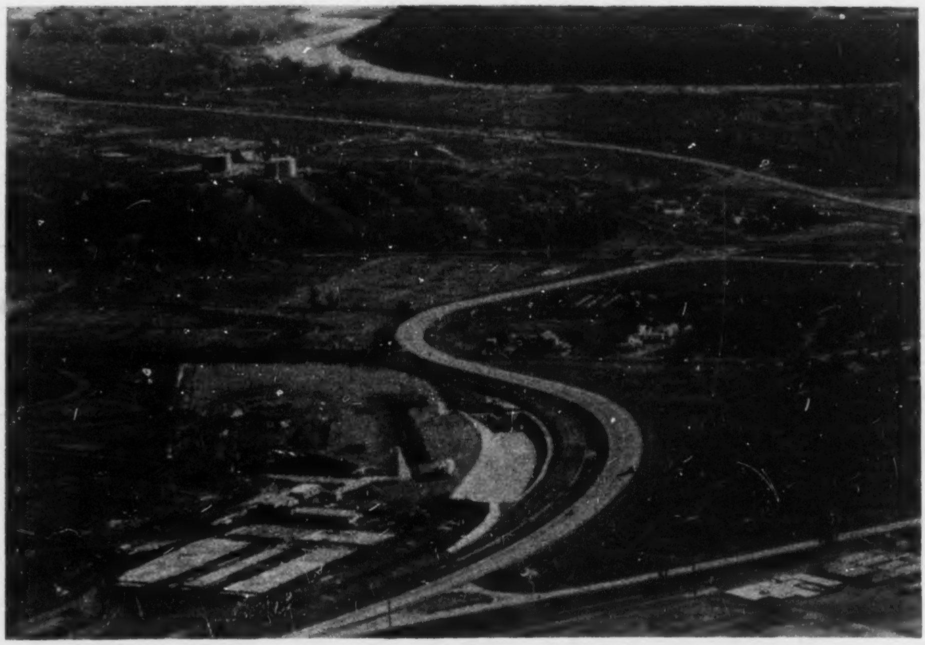


Figure 17

We have also recognized the need for roads, primarily to serve our project. As we started our project, the only access up Parachute Creek was through the town of Parachute itelf. That access consisted of a two-lane road that you can see in the lower right of this picture. It passes by the Parachute school. We did not think it wise to increase traffic significantly on that street partly because of the increased risk to the school children. We instead constructed a bypass around the east side of town to handle the industrial traffic. That bypass is about 1 mile in length. (Figure 17.)

We have also improved the road to our plant site. That work was done jointly with the Colony project, which lies just north of our project. The Union share of that road has been in the neighborhood of $7.9 million.

Finally, recognizing the need for additional schools, we have entered into agreement with the school district which serves the town of Parachute and the surrounding area, to fund, or secure financing for a new middle school. That school is designed to initially educate 225 students. It is designed so it can be readily expanded to accommodate 450 students. As you see in this slide, that school is now under construction. It is scheduled to be completed in January of 1983. This slide shows an artist's rendition of the school.

That is the end of the slides and the end of my presentation today. Hopefully we have left enough time for questions.

[The prepared statement of Mr. Randle follows:]

TESTIMONY OF ALLEN C. RANDLE, VICE PRESIDENT, OIL SHALE OPERATIONS, ENERGY MINING DIVISION, UNION OIL CO. OF CALIFORNIA

UNION OIL COMPANY OF CALIFORNIA
PARACHUTE CREEK SHALE OIL PROGRAM
SOCIOECONOMIC IMPACT MITIGATION EFFORTS

INTRODUCTION

Union Oil Company of California has committed nearly $63 million through 1983 to mitigate socioeconomic impacts on communities in Garfield County, Colorado, where our oil shale project is currently under construction. After determining that housing was one of the most significant needs for workers moving to Garfield County, we dedicated major portions of these impact dollars to providing housing. Other expenditures have been in the form of direct aid to the communities to provide much needed services for growing populations.

Before recent shale oil development in this northwest corner of Colorado, the town of Parachute had a population of less than 400 residents. It had one law enforcement officer, a cafe, a small grocery store, a part-time town manager and a single school for all grade levels. Today, Parachute has a population of more than 1,400, and the new nearby community of Battlement Mesa has 1,600 residents. Parachute now has a five-officer police force, three new dining establishments, two new area schools under construction, and a full-time town manager. A new town hall is under construction, and a new fire hall is planned. Ten sheriff's deputies are now based in the area.

Because Garfield county has changed dramatically during the past year, industry has worked closely with local government officials to determine the needs associated with growth and the best way to meet those needs. Before proceeding it may help to review the history of Union Oil's shale oil project and its current status to better understand the impacts of the project on the area.

HISTORY

Union Oil Company of California is a shale oil industry pioneer. To date, our entire project, from early research and development to construction of this first 10,000 barrel per day module, has been funded from company resources. Union Oil Company began its shale oil venture over 60 years ago by acquiring properties in the Parachute Creek area of the Piceance Basin in Garfield County, Colorado. Union Oil now owns in fee 30,000 acres of property in the Parachute Creek area, including 20,000 acres of oil shale resource land and 10,000 acres of valley land. This property contains some 1.6 billion barrels of recoverable oil in the high yield mahogany zone alone. These reserves are large enough to produce 100,000 barrels of shale oil daily for over 40 years. The entire Western U.S. oil shale resource is estimated to be 1.8 trillion barrels of oil, triple the size of Saudi Arabia's oil resources.

Union Oil has been doing research since the early 1940's to develop technically, environmentally and economically feasible methods for extracting usable oils from shale. From 1955 to 1958, Union built and operated a 300 ton per day semiworks plant in Parachute Creek which eventually processed up to 1,200 tons of shale ore per day and produced up to 800 barrels of shale oil per day.

The low price of imported crude oil forced Union to suspend full scale commercial development at that time, but Union scientists and engineers continued to improve the unique Union upflow retorting process. With the oil shortages caused by the Arab oil embargo in 1973 and the national call for synfuel development in 1978, Union accelerated its effort to achieve commercial shale oil production as a hedge against the possibility of future supply disruption.

PHASE I

Union announced plans in late 1979 to build the first commercial shale oil complex in the nation. The $500 million first phase is now under construction and is scheduled to begin producing 10,000 barrels per day of high quality synthetic crude oil by mid-1983. The Phase I project includes a mine, retort and upgrading facility. Union began the permitting process in March, 1978 and had all the federal, state and local permits for the project in early 1981, approximately three years later. Necessary road work to the site began in the fall of 1980, and pre-development mining operations began in January of 1981. On-site construction of the retort and upgrading facilities began in late 1981.

The mine for Phase I is located about 1,000 feet above the valley floor on the north canyon wall above the east fork of

Parachute Creek. The mine portals open onto a five acre bench site carved from the side of Long Ridge. The retorting complex is being built on this bench. Three miles north of the town of Parachute, along County Road 215, an upgrading facility is being constructed to process the raw shale oil into a high quality, low sulfur synthetic crude which will be transported to existing refineries. In the room and pillar mine, the overall mining height will be 60 feet. An underground facilities area has been excavated where workers are now constructing mine offices, a miner change room, maintenance shops, and a warehouse. Also, the shale ore will be crushed and stored underground.

WORK FORCE

Currently, contractors on the project have about 1,600 employees. The peak construction work force for Phase I is projected to be 2,400 which should be reached in June of this year. The work force will stay at that level until August, when it will begin to decline. The facility operating work force will be about 500.

The construction work force is monitored on a quarterly basis and a profile of the workers is supplied to local officials to help assess community needs. The profile includes: place and type of residence, number and ages of children, place of previous residence, as well as other information.

Union has emphasized local hiring, to the extent possible, in order to minimize impacts resulting from population influx. The most recent worker profile report shows that 27% of the work force required no change in residence to take their present job, while another 17% previously lived in other Colorado communities.

IMPACT MITIGATION EFFORTS

Housing - From the beginning, Union Oil Company recognized its responsiblity to assist in making housing available for the large number of workers involved in the project. Union has provided $23,116,000 for oil shale employee family housing. This amount includes the cost of building 126 townhomes and cluster homes at Rifle, 192 apartment units at Parachute, 40 mobile homes at Parachute and property for additional housing if needed in both communities.

These housing units are rented to contractor employees at a rate that covers their cost to the company. The Rifle units were built by several different developers using local manpower where possible. The units have two or three bedrooms and all appliances, including washers and dryers. They rent for $575 to $700 per month, including all utilities.

The Parachute apartments are two and three bedroom units. They also have all appliances, are available furnished, have fireplaces, patios and skylights. The housing complex has a large common area which incorporates a playground for children. The apartments rent for $360 to $450, utilities included.

The mobile homes are located on lots that have been platted for eventual single family residence construction. The 14 x 70 foot mobile homes have three bedrooms and are furnished.

For single status workers, we built a singles housing complex on our property four miles north of Parachute near County Road 215. The singles housing complex will cost $24,800,000 through completion of construction of Phase I. There are currently 750 units in place, with capacity and permits, to expand to 1,400 units if necessary. Some expansion is now under way. Residents of the complex pay $45 per week for room and board. Each worker has a private, fully furnished room with bath facilities. Maid service and laundry service for linens and towels is provided once a week. The workers eat in a central dining facility and are provided three meals a day. For lunch, workers pack their own lunch from a wide variety of sandwiches, pastries, fruits and salads that are prepared for them.

The employees can also take advantage of a number of other facilities at the complex. The prime contractor, Daniel Construction, is responsible for operating the facility. There is a multi-purpose outdoor playing field for football, soccer and softball. There are three half-court basketball courts, three volley ball courts, three horse shoe pits and a full-court basketball court that can be flooded in winter for ice skating. There are quiet areas and a picnic area with tables and barbecue pits. All roads and parking areas are paved.

The community center houses a 24-hour first aid center staffed by a physician's assistant and a registered nurse. The center also houses the administrative office, the security office, a fire truck, an ambulance, a barber shop, a commissary, a club room with televisions, a telephone room and an exercise room with weight lifting equipment. In the "node" center is the dining hall that seats up to 500 people and a self-service laundromat for personal laundry. There is also a game room with pool, shuffleboard, checkers, chess, darts, electronic games and pinball.

We also have an "all faiths" chapel at the center. Ministers from the Rifle and Parachute communities hold services on Sundays. When needed or requested, Reverend Larry Holtzclaw of Parachute is available for counselling sessions with workers.

The singles housing complex has a central sewage treatment plant and a central potable water treatment plant.

The complex was built to attract single status workers to the project. From the beginning we realized that the large number of construction workers necessary for the project would place a huge demand on existing community housing and community services. By attracting single status workers to the project during the construction phases, rather than family status workers who may bring two, three or more additional people to the area, Union wants to keep 'people impacts' to a minimum until permanent housing, schools and community facilities can be built.

In summary, Union has already provided 358 family housing units and 750 single status housing units. This breakdown between family and single status housing was based on construction history on remote construction projects. A significant number of workers on such a construction project are on single status. Union is helping to keep the population influx to a minimum by providing single status housing.

Town of Parachute - Union Oil Company's impact mitigation expenditures include $136,000 to the town of Parachute to purchase property for a new town hall and a new fire station for the Grand Valley Fire Protection District. Construction of the town hall on the two acre site is now complete. It houses chambers for the town trustees, administrative offices and the police department. Three thousand dollars have been provided to the fire district to prepare preliminary drawings and estimates for the new fire station.

Union Oil is also making an annual contribution to cover administrative costs for the town of Parachute, totaling $26,667 from May 1981 through December 1983. We are providing $2,500 annually from May 1981 to the end of 1983 for Parachute medical service, with a total commitment of $6,667 through the end of 1983. And Union is financing a fire truck for the fire district at a cost of $72,000.

Union contributed $129,143 to the Parachute police force, including one automobile and two police officers' salaries.

In addition to direct financial assistance to the communities, Union has been able to prepay some fees in conjunction with its housing development, so the money can be utilized for front-end financing of facilities. Union prepaid 200 water and sewer tap fees to the town of Parachute at a cost of $600,000. The water and sewer taps have all since been utilized at our housing projects. Since the fees were paid in a lump sum, the town had sufficient funding to upgrade the municipal water and sewer systems. $250,000 in annexation fees have also been paid to Parachute.

In addition, Union has donated 5 acres of land adjacent to its housing property to be developed as a town park.

Garfield County - Union has contributed $251,270 to the Garfield County Sheriff's Department to provide equipment and salaries for five deputies in the Parachute-Battlement Mesa area through the time period that the singles housing complex is being utilized.

We are also assisting Garfield County in funding a solid waste study at a cost of $25,000.

Union also sought to address the socio/psycholcgical demands our workers would place on area human services. To this end we were requested to contribute $31,450 to the County. A block of funds was assembled from matching grants, revenue sharing, and industry to distribute in accordance with a priority needs list contained in a human services plan which has since been developed. (The County placed $85,000 from its revenue sharing funds into the block and then sought $210,000 from the State Division of Impact Assistance. In order to receive those funds, the County asked that industry match the county contribution of $85,000. Each company was asked to contribute according to the number of workers living in Garfield County that were employed by the individual project. Union Oil Company, responsible for 37% of the work force at that time, contributed the $31,450 requested.) The money is being used to cover the costs of a number of human service impact mitigation activities, including public health, substance abuse, mental health, developmental disabilities, social services, employment, referral, community action and services to transients, adolescents and senior citizens.

Roads - Union Oil Company and the Colony Shale Oil Project are sharing the cost of realigning and upgrading the 10.8 miles of County Road 215 from the town of Parachute to the project security gates. Union's share for this project is $7,900,000. The road work includes a bypass around the town of Parachute that will link with the new four-lane Interstate Highway 70 which the State Highway Department is currently constructing.

Union has also committed $93,000 to a highway bypass around Rifle. This amount represents Union's share of an industry commitment to build the bypass. This money may not be used since bids on the bypass came in much lower than anticipated and the County had some funds available for the project.

Schools - Union Oil Company is financing the cost of a new $4.2 million middle school for School District 16. The school is under construction on Stone Quarry Road in Battlement Mesa and will accommodate 225 students and can be readily expanded for 450. It will serve the communities of Parachute and Battlement Mesa, as well as surrounding areas. It will have nine regular classrooms plus rooms for art, home arts, special education, science, shop and technical arts, chorus and band. Included is a library and a full-size gymnasium with an adjacent practice gym. Also included is a kitchen which will eventually prepare meals for up to four area schools, or a maximum of 1,800 meals each day. The cafeteria will have both a dining and commons area for student use. The 44,535 square foot L. W. St John Middle School is scheduled for completion September 1, 1982.

Emergency Service - Union contributes $24,000 each year to the St. Mary's Air Life helicopter emergency service in Grand Junction. This contribution helps cover the basic costs of keeping this emergency service available.

Cumulative Impacts Task Force - Union Oil Company is an active participant in the Cumulative Impacts Task Force (CITF). The task force was established to assess the cumulative impact of energy development on local governments in six counties of northwestern Colorado. The task force product will be valuable planning tool for all taxing agencies in the six county region. The agencies can use the CITF data to determine not only population impacts on services, but to forecast the additional income that will be generated by the energy developments. The CITF is being funded by industry and local and state governments. Union Oil Company's share of the CITF financing is approximately $15,000.

SUMMARY

Although Union has not honored every request, we have made significant contributions toward fulfilling our community responsiblity to be a "good neighbor."

As a result of the commitments listed in the foregoing pages, the immediate burden on limited town and county tax revenues has been substantially lessened. Once our project is on the tax rolls, adequate funds will be available to maintain and improve services without direct assistance from the private sector. Most of the impacts associated with Union's pilot project have been addressed; others will receive our ongoing attention. Union expects to continue to work with local and county officials to mitigate new problems as they arise.

PHASE II

Union Oil Company is currently in the process of permitting a second phase of the Parachute Creek Shale Oil Program. Phase II development is planned to be completed in 1993 with total production at 90,000 barrels per day. Union Oil has entered the Colorado Joint Review Process to permit the project expansion. We want to have all permits by mid-1983 so that construction can begin.

The expansion will be a phased development in an effort to reduce the socioeconomic impacts on the surrounding communities. Instead of starting work on eight new retorts in 1983, Union will build the retorts in pairs and add corresponding capacity to the upgrading facility. This will enable the contractors on the expansion phase to keep a steady work force on the job for a longer period of time rather than reaching an extremely high work force peak for a brief period of time followed by a quick reduction in manpower.

With our phased development program, the contractors will complete two new retorting units at a time, then move on to the next two. We expect the work force to peak at approximately 3,000 people with the permanent operating work force, for the entire 90,000 barrel per day project, at 2,600. In conjunction with the Phase II permitting, Union Oil Company is designing a plan to mitigate community impacts caused by the additional development. We have recently added a socioeconomist to our oil shale operations staff to coordinate this study.

Local officials have voiced their pleasure that, to this point, no serious problems have been encountered as a result of the increased population. With proper planning, continued attention and cooperation between the private and public sectors, that situation is likely to continue.

UNION OIL COMPANY OF CALIFORNIA

Parachute Creek Shale Oil Program

Community Impact Mitigation

Single Status Housing (to minimize number of employees in community)		$24,800,000
Housing for Construction & Permanent Employees		24,132,000
Direct Assistance to Communities		12,967,197
Parachute bypass	$ 500,000	
Upgrade County Road 215	7,400,000	
Parachute law enforcement	129,143	
Parachute administration	26,667	
Parachute emergency medical services	6,667	
Parachute middle school	4,200,000	
Parachute fire hall architectural services	3,000	
Parachute town hall and fire hall property	136,000	
Parachute park land	150,000	
Grand Valley fire district truck	72,000	
Garfield County sheriff's department	251,270	
Garfield County solid waste study	25,000	
Garfield County human services	31,450	
Garfield County School District #12	30,000	
Air Methods - emergency helicopter	36,000	
Other		864,705
Cumulative Impacts Task Force	14,705	
Parachute water and sewer tap fees	600,000	
Parachute annexation fees	250,000	
Total Impact Mitigation Costs		$62,763,902

Parachute Creek Shale Oil Program

union

Shale Oil: A Viable Alternative

Development of alternative fuels to supplement the nation's limited conventional oil and gas production is critical. Dependence on imported crude oil threatens our country's security as well as its economic well being.

Of the alternative fuels, shale oil is the closest to conventional crude oil. It comes from a marlstone, several times the strength of concrete, containing a complex organic compound, kerogen. By heating this rock to temperatures of 700 to 900° F, the kerogen is released to form crude or "raw" shale oil.

Shale oil contains more hydrogen and fewer impurities than synthetic fuels made from coal. Present day technology enables a suitable refinery feedstock to be produced from shale oil more economically than from other alternative fuels.

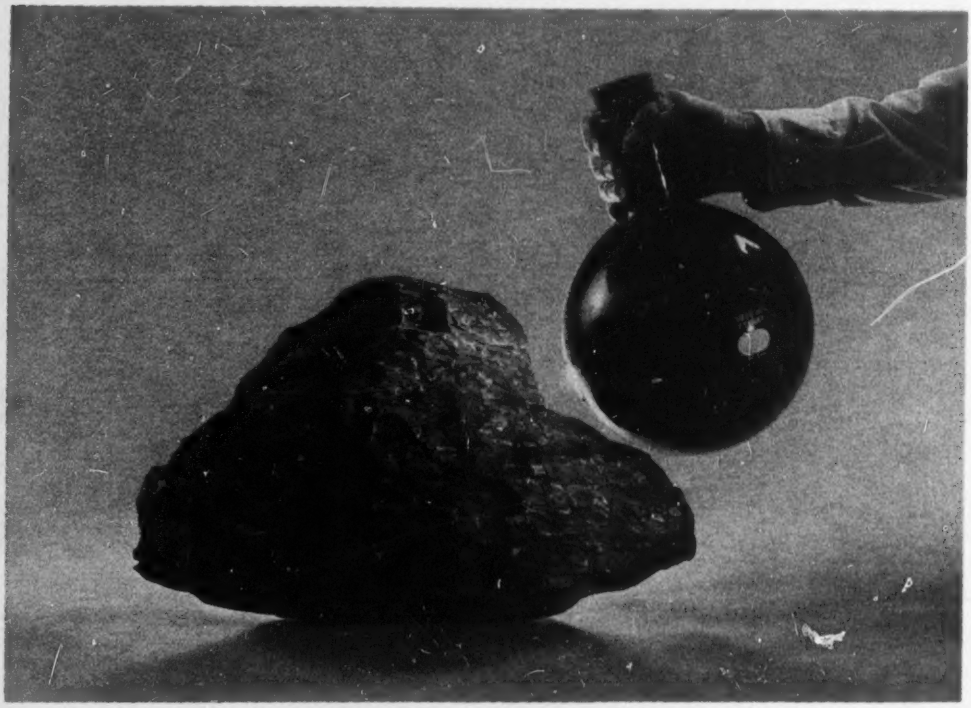
While oil shale is found in many parts of the United States, the Rocky Mountains contain the richest deposits. A government study estimates that there are 1.8 trillion barrels of high grade shale oil locked in the Green River formation in Colorado, Utah, and Wyoming.

If only 600 billion barrels, or one-third of this shale oil, is ultimately recovered, it would represent about 20 times our nation's current crude oil reserves.

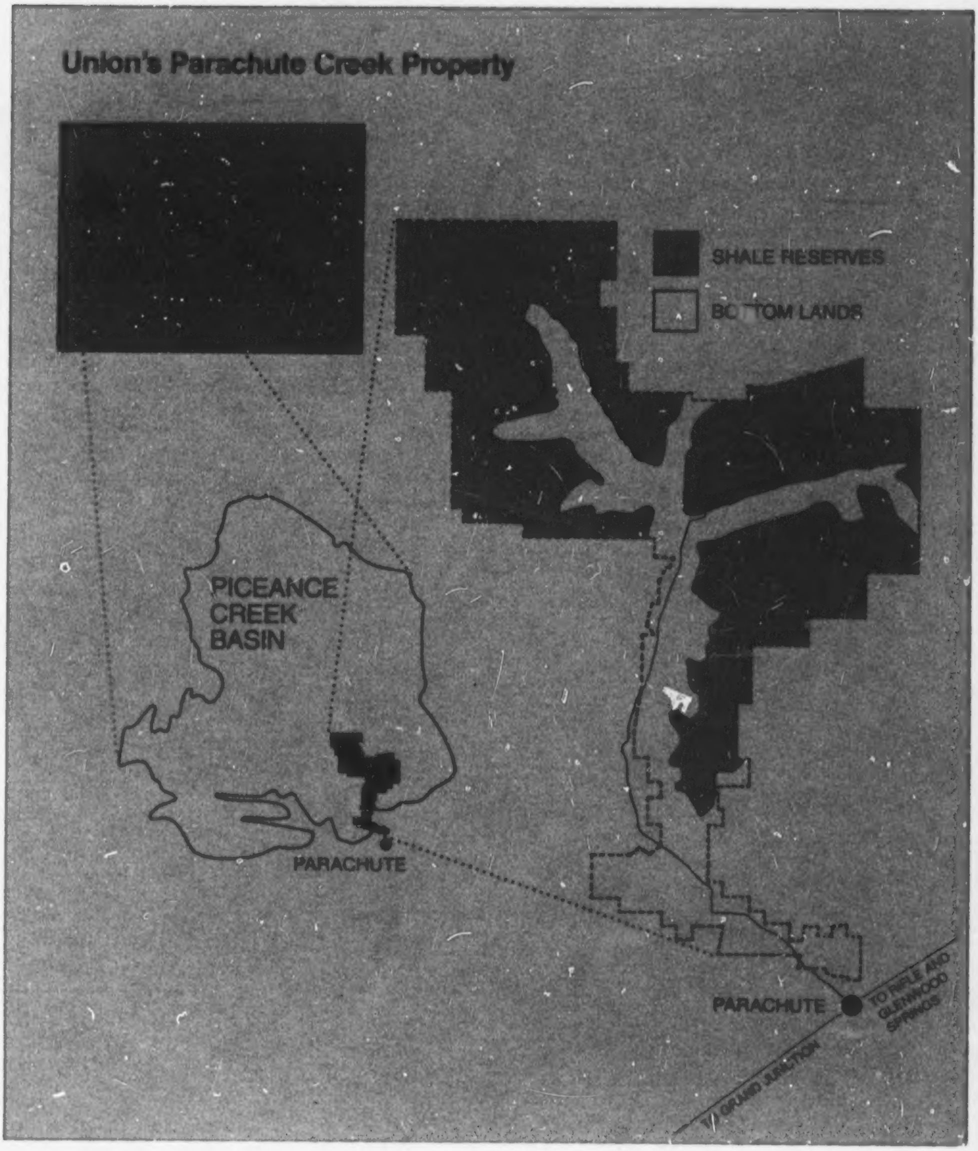
Up to 85 percent of the country's richest and most accessible shale oil reserves lie in the Piceance Creek Basin in western Colorado.

It is here that Union Oil Company of California will convert this resource into usable energy for Colorado and the nation. Completion of the Parachute Creek Shale Oil Program that Union Oil is constructing will help to establish a new source of energy to supplement shrinking domestic crude oil and natural gas production.

This brochure describes Union's effort to achieve commercial shale oil production.



This piece of oil shale rock, weighing almost 59 pounds, will yield one gallon of shale oil when subjected to temperatures of 700 to 900 degrees.



Union's Parachute Creek Property

SHALE RESERVES
BOTTOM LANDS
PICEANCE CREEK BASIN
PARACHUTE
PARACHUTE
TO RIFLE AND GLENWOOD SPRINGS
TO GRAND JUNCTION

Union Oil: A Shale Pioneer

More than 60 years ago, Union Oil began acquiring properties in the Parachute Creek area of Garfield County in northwestern Colorado. The oil shale lands Union owns contain some 1.6 billion barrels of recoverable oil in the high yield Mahogany zone alone. These reserves are large enough to produce 100,000 barrels of shale oil each day for more than 40 years. In addition, there are about two billion barrels of reserves in adjoining lower quality zones.

Fully aware of the potential energy value of these holdings, Union's research scientists have conducted a wide range of laboratory and field studies for nearly 40 years. This research was aimed at developing technically, environmentally and economically feasible methods of extracting usable oils from shale.

In the early 1940s, Union built and operated a small, 50-ton-per-day pilot retort at its Los Angeles refinery. This study continued into the early 1950s. From 1955–58, the company field tested its retort techniques in Parachute Creek Valley, processing up to 1,200 tons of ore per day and producing about 800 barrels of shale oil per day. This was the largest oil shale retort ever operated in the United States.

As a result of this extensive research, Union perfected its own retort process. It utilizes a unique upflow system that enables a more efficient operation than with other retorting techniques.

The upflow technique produces a lighter, more easily refinable oil, eliminates the oil shale agglomeration associated with other retorting methods and results in a more thermally efficient operation.

The company also developed technology for treating the oil so that it could be processed in a conventional refinery. In the 1950s operations, more than 13,000 barrels of shale oil were processed into gasoline and other products at a refinery near Fruita, Colorado.

Low world oil prices in the 1950s and 1960s forced Union to put the project on the shelf—though research efforts continued. Following the 1973 oil embargo and the rise in the world price of crude oil, the company accelerated its efforts to achieve commercial shale oil production.

In addition to its own efforts, Union has engaged experienced engineering firms to evaluate the company's mining and retorting techniques. This evaluation has convinced Union that it indeed has a viable process for extracting oil from shale.

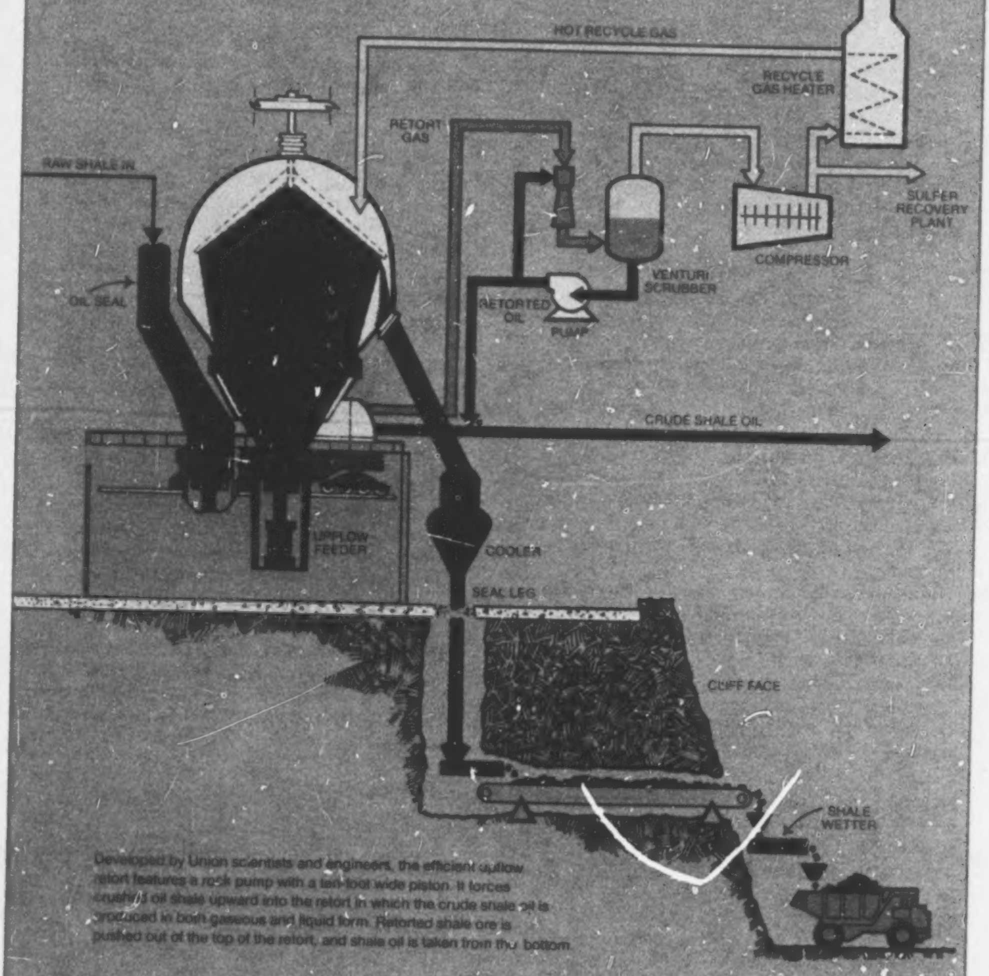
The process is extremely energy efficient. For every equivalent barrel of energy used, the equivalent of five barrels of energy is produced.

Union's extensive pioneering investment in oil from shale has been recognized by the U.S. government. In July 1981, the company was the first to be awarded a contract under a Department of Energy program designed to encourage the development of commercial shale oil production in this country.

The contract provides certain price protection to Union and requires delivery to the Department of Defense of 3,000 barrels of military aircraft jet fuel and 7,000 barrels of diesel fuel per day for a period of seven years once production is established—in mid-1983.

Union's retorting complex is being constructed on a five-acre bench site outside the mine entrance. The bench has been cleared and work on the 200-foot tall, 10,000 barrels per day retort will be completed in 1983.

Union Upflow Retort


HOT RECYCLE GAS
RECYCLE GAS HEATER
RAW SHALE IN
RETORT GAS
SULFER RECOVERY PLANT
COMPRESSOR
OIL SEAL
VENTURI SCRUBBER
RETORTED OIL
PUMP
CRUDE SHALE OIL
UPFLOW FEEDER
COOLER
SEAL LEG
CLIFF FACE
SHALE WETTER

Developed by Union scientists and engineers, the efficient upflow retort features a rock pump with a ten-foot wide piston. It forces crushed oil shale upward into the retort in which the crude shale oil is produced in both gaseous and liquid form. Retorted shale ore is pushed out of the top of the retort, and shale oil is taken from the bottom.

Union Oil Company's Parachute Creek Shale Oil Program

Union Oil Company began construction in January 1981 on its oil shale mining and retorting project north of Parachute, Colorado, along Parachute Creek. Denver is 200 miles east and Salt Lake City 320 miles northwest of the site.

The company's holdings consist of about 20,000 acres of oil shale lands and 10,000 acres of valley lands and include water rights and adequate acreage for deposition and vegetation of retorted shale.

The first phase of the program includes a mine, a large shale retorting unit, an upgrading facility to remove impurities from raw shale oil and convert it to a high grade synthetic crude, provisions for disposal of the retorted shale, and necessary support facilities. To be completed in 1983 at an estimated cost of $500 million, it is designed to process 12,500 tons of shale and produce about 10,000 barrels of shale oil daily.

With this operation, the company will be able to verify the technical, environmental, and economic soundness of a commercial-sized plant.

Shale for the initial project will be mined from the rich Mahogany zone of the Parachute Creek section of the Green River geologic formation. In the first zones being mined, an average yield of 34 gallons of shale oil per ton of ore is anticipated.

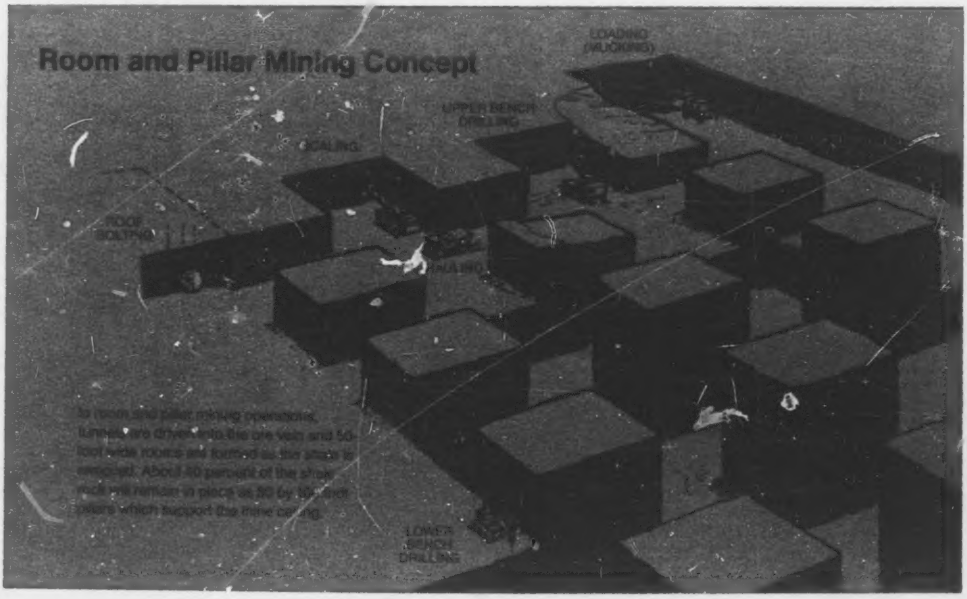
The entrance to the underground mine will be located about 1,000 feet above the valley floor and will open on the south side of Long Ridge, which forms the north wall of the East Fork of Parachute Creek.

Conventional room and pillar mining techniques will be employed. Preliminary plans call for 50-foot wide rooms supported by 50 by 100 foot pillars and an overall mining height of 60 feet. Support facilities, such as offices, maintenance shops and locker rooms for the work force, also will be located underground.

In the mining operation large hydraulic drills, called "jumbos," will bore holes for explosives in the mine face. Explosive charges will free the rock and large front-end loaders will load the ore into 50-ton off-road trucks. These trucks will haul the shale to the primary crusher in the underground shale preparation area.

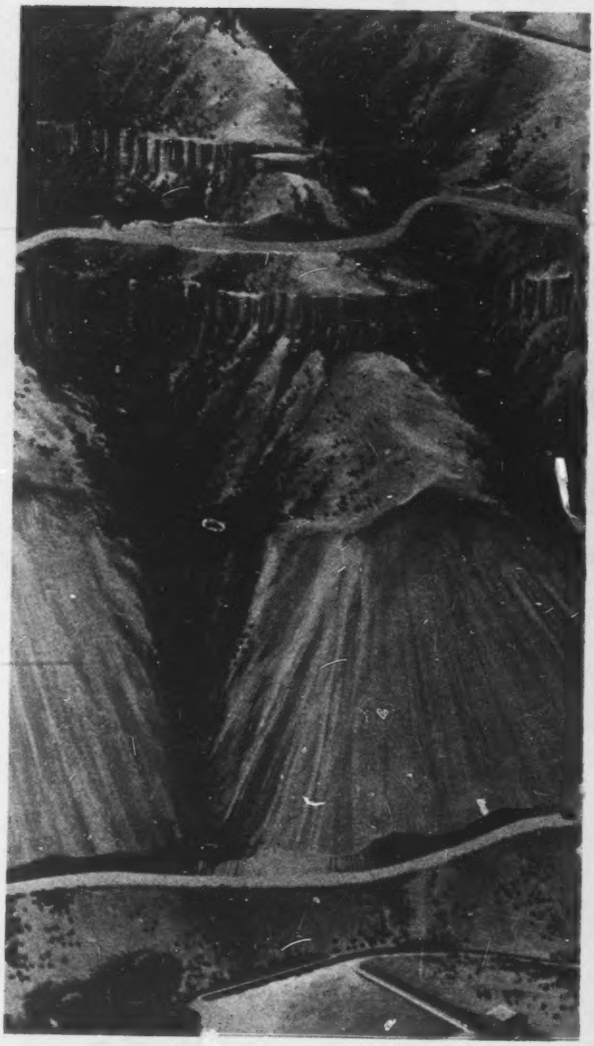
Shale ore will be crushed in two stages to less than two-inch pieces to produce a size suitable for the retort. It will be transported to the surface by conveyor belt and given a final screening before being fed to the retort.

Union's upflow retort, to be located on a five-acre



Room and Pillar Mining Concept

In room and pillar mining operations, tunnels are driven into the ore vein and 50-foot wide rooms are formed as the shale is removed. About 40 percent of the shale rock will remain in place as 50 by 100-foot pillars which support the mine ceiling.



This sketch shows Union's oil shale program. Crushed and screened shale will move from the underground mine onto a five-acre bench site. It is fed into the retort to extract the shale oil. The retorted shale moves by conveyor to the enclosed chute and down to the bottom of the valley for spreading and vegetation. A drainage pond (lower left) will capture runoff water from the retorted shale deposits, for use in the retorting process. The East Fork of Parachute Creek (lower right) will be protected from recycled water and other contaminants.

bench site just outside the mine entrance, will be a large piece of machinery—200 feet or 18 stories in height. Crushed ore enters the rock pump underneath the retort where a 10-foot diameter piston will force the ore upward into the retort.

Heated gas will enter the top of the retort, decomposing the kerogen contained in the shale and producing the raw shale oil in both gaseous and liquid forms. Most of the hot vapors will condense. Remaining high quality gas can be purified and burned to heat the recycle gas within the retort system and to provide steam to operate the retort equipment.

The retorted shale, with all the oil removed, will be forced up and over the edge of the retort cone and then fall by gravity through a cooling system.

The cooled retorted shale then will be moved by conveyor belt to an enclosed chute which will transport it to the canyon floor. It will be spread, compacted, contoured and vegetated with native plants to blend into the surrounding landscape.

After solids suspended in the raw shale oil are removed, the crude oil will be transported by pipeline to the upgrading facility eight miles south of the retort.

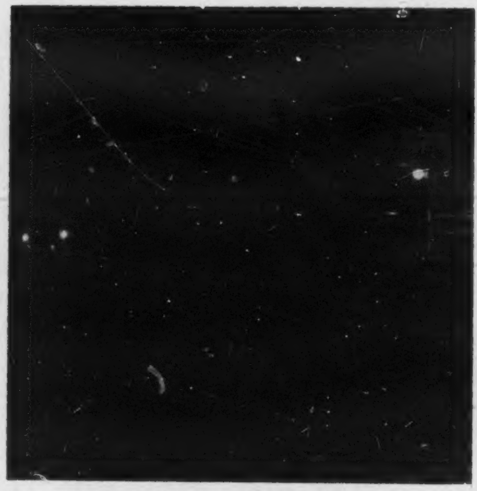
There hydrotreating, a process in which the oil is subjected to high temperatures and pressures in a hydrogen atmosphere and in the presence of a catalyst, will remove the impurities. The resulting synthetic crude can be converted readily into high octane gasoline and jet or diesel fuel in a refinery.

Following the opening of the room and pillar mine in 1981, Union Oil will construct underground facilities for preparation and storage of the oil shale ore and for necessary support services. Full scale mine development, aimed at producing 12,500 tons per day of ore, will begin in mid-1982.

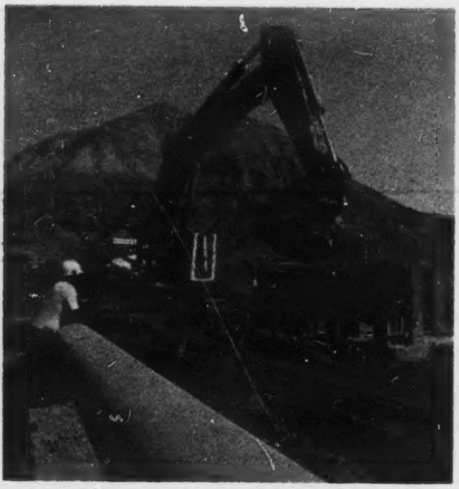
Union is targeting mid-1983 for start up of the retorting and upgrading facilities. Following a "break in" period, the system will reach its full design production of 10,000 barrels of "syncrude" per day later that year.

With successful operation of the Phase I facilities, and assuming necessary federal, state, and local government permits are secured on a timely basis, Union then will build four or more 10,000 barrel per day retorts, open additional mine areas, and construct the necessary upgrading facilities for the project to reach 50,000 to 100,000 barrels a day production by 1988.

"Jumbos," large, self propelled hydraulic drills, bore holes ten feet into the mine face for explosives.



Following the blasting of a mine face, a front-end loader lifts the ore into a 50-ton truck which will haul it to the underground crusher.



Work on the shale oil upgrading site is progressing on a schedule that will see its completion in 1983.

Safety is ensured by placing roof bolts in holes drilled deep into the ceiling of the rooms of the mine.

Environmental Protection

Changes in the land surface resulting from construction of the mine and processing facilities will not be visible outside the upper Parachute Creek Valley. Because of the isolated location of the private property where operations are planned, alterations in the topography will be apparent only to visitors coming to the site on business.

Steps will be taken to preserve and restore vegetation and to protect the area's wildlife and wildlife habitat. Revegetation of retorted shale has been successfully demonstrated and will be carried out on the retorted shale disposal areas. Union has worked with Colorado State University on the development of optimum vegetation methods.

Another primary goal will be to safeguard local streams and underground basins. The bottom ten-foot layer of retorted shale will be compacted to reduce water movement upward or downward.

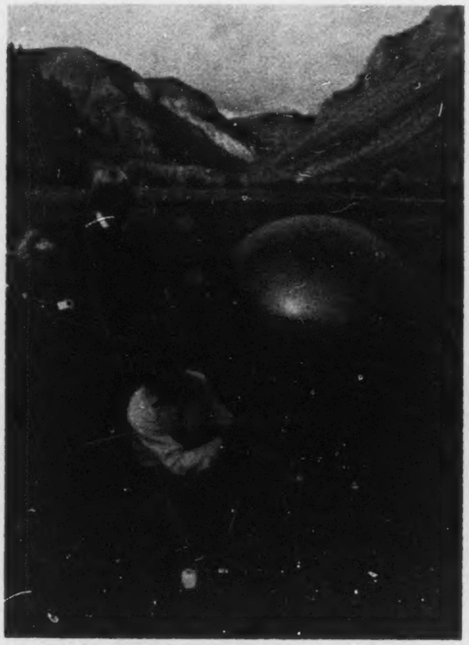
Monitoring of retorted shale is planned, and erosion testing is an on-going activity.

During construction and operation of the shale oil program, air quality in the immediate operating area will be protected. Special controls will be installed as part of plant construction. Exhaustive studies indicate that the low emission levels will meet all federal and state air quality standards and will not be harmful to residents of the area, to vegetation or to wildlife.

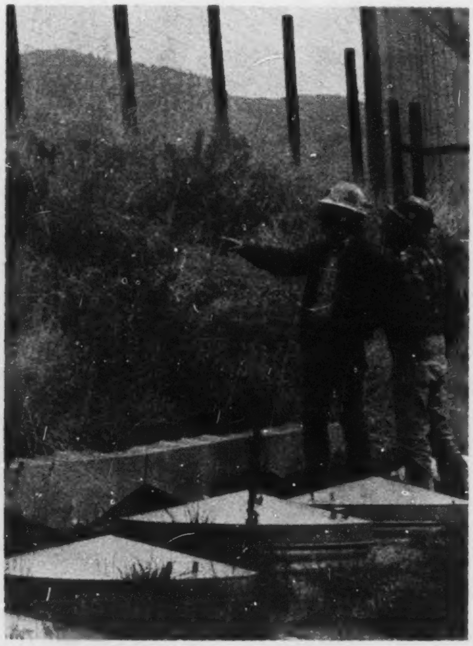
As operations begin, Union will monitor environmental factors continuously to ensure that standards are met.

Water for the first 10,000 barrel per day phase of the project's operations will be taken from wells on Union's property and will be recycled to minimize water requirements. Union's water rights were secured many years ago as a part of the company's long-term plan for shale development. As future retorts and process facilities are added, water also will be drawn from the Colorado River, where Union has long-established water rights.

All of these activities are designed to ensure an environmentally acceptable operation.



Every effort is being made to safeguard air quality and meet all federal and state standards.



Best procedures to vegetate retorted shale ore have been determined by use of these test plots.

Social and Economic Benefits

Union recognizes that local communities will need to expand housing and public services to provide for a growing population drawn by oil shale development. Every effort is being made to assist in handling this growth and preserving the life style enjoyed in western Colorado.

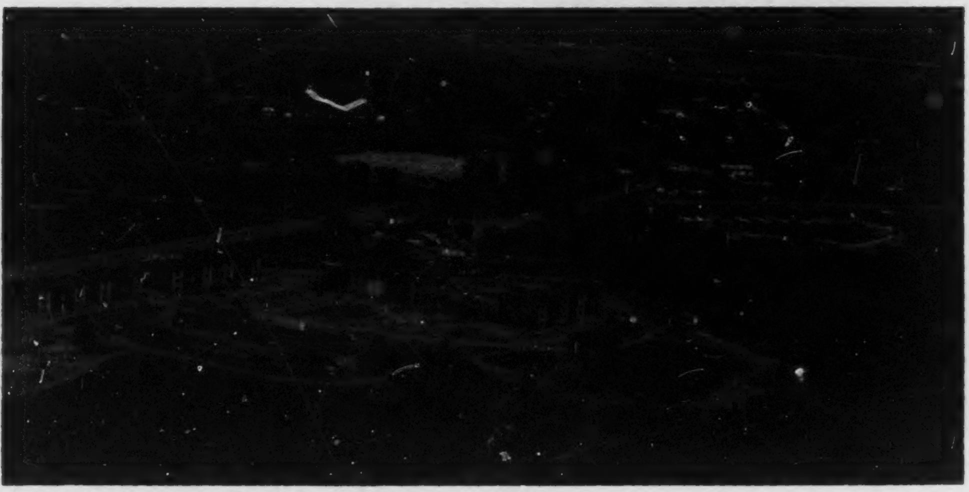
Once Union's Phase I facilities are on the tax rolls, the taxes and other revenues received by the state, county and local communities will more than offset the costs of services the population influx will require.

Union is assisting local governments during this transition period. The company is constructing housing and working with local officials in financing services, such as schools, highways, water and sewer systems and public safety. The company has expended or committed nearly $60 million through 1983 to ease social and economic impacts of the project in Garfield County.

The company is providing funds for emergency medical services, administrative services, law enforcement and fire protection in Parachute as well as solid waste studies and law enforcement enlargement in Garfield County.

Union also is providing $4.2 million to finance a Parachute area middle school that will be ready for occupancy in fall, 1982 and has contracted for $6.6 million in highway improvements.

Union is providing funds to local government for public safety as well as services and highways.



This housing complex in the town of Parachute, with condominiums in the foreground and mobile homes in the background, was built to supplement local housing available to program workers.

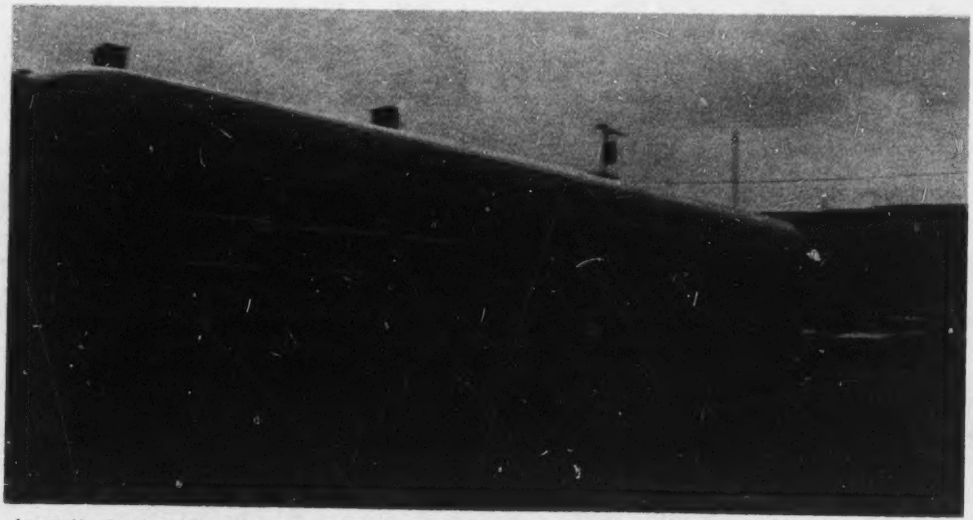
The company is developing single workers' housing on its property adjoining the project site. Initially, this will accommodate 750 workers. It can be expanded to house up to 1,400 if the need arises. The facility, complete with cafeteria and recreation center, will be self-contained and will provide all services needed by resident construction workers.

Additional housing for employees who wish to bring their families to the area is being provided to supplement housing available or provided by local real estate developers. The company has built, or has under construction, 192 apartment units, 129 condominiums and 40 mobile home units.

About 1,200 workers currently are employed on the project. This figure will rise to 1,600 in the second quarter of 1982 and average about 1,500 for much of the next year. As construction of Phase I nears completion in 1983, the work force will decline, stabilizing near 450 in the operations phase.

During construction, the payroll will average about $25 million annually. After state and federal taxes, the workers should have some $15 million of disposable income. During the operating phase, these figures should be about $12 million and $8.5 million, respectively.

Housing on Union's property near the project site is being constructed to accommodate 750 single workers.



As part of its efforts to assist local communities, Union is financing a new middle school that will be ready to accept students in the fall of 1982.

Mr. FUQUA. Thank you very much, Mr. Randle. We will hold questions until the three of you have finished, and then we will have questions.

We will now hear from Dr. Robert King, the manager of the community development for TOSCO Corp. Dr. King?

Mr. KING. Thank you very much, Mr. Chairman. I appreciate the opportunity to discuss with you the socioeconomic impact mitigation program of the Colony shale oil project.

TOSCO Corp. was founded in 1955 to develop and license a process for extracting oil from shale. As we developed that process we also began to put together the Colony project.

TOSCO was one of the original partners in the project, and TOSCO remains a 40-percent owner. In 1980, the other 60 percent of the project was acquired by Exxon Corp. Construction on the Colony project began in 1980 and we anticipate completion of the project by 1986. The project, as it is now conceived, will provide for the production of 47,000 barrels per day of upgraded shale oil.

As we began the development of processes for extracting oil from shale, TOSCO also became concerned about the consequences of socioeconomic impacts that would be associated with the project due to large numbers of people who would be moving into the area, and as a result, very early on, TOSCO began the study of impact mitigation and the development of impact mitigation strategies.

As we have undertaken this work, it became evident to us there are a number of basic problems associated with large-scale energy development, and particularly synthetic fuel projects but other large-scale projects as well.

The first problem is that the development of these projects generally has taken place in rural areas which lack infrastructure to handle large increases in population. A second problem is that the population influx associated with the construction and operation of these projects is substantial. A third element is that there is usually a degree of uncertainty associated with the timing of the project, which creates difficulty for local governments in planning and preparing for the kind of impacts that are associated with synthetic fuel and large-scale energy development.

There are also problems which result from the fact that the construction work force generally is much larger than the permanent operations work force. This requires dealing with the needs of a substantial construction peak work force, but the long-term workforce requirements are much smaller.

We have encountered two major difficulties for local governments, that I think are general to all such projects. First is the problem of front-end financing. The tax revenues that these projects generate are substantial, but unfortunately the requirements for local services and local capital facilities occur before the tax revenues that result are available to mitigate those impacts.

Second, frequently the local government jurisdictions in which impacts occur (that is, the area in which the new population chooses to settle) are not necessarily the same ones in which the project is located. Hence, tax revenues do not always flow directly into jurisdictions where impacts occur.

As a result, each specific project requires a specific mitigation program related to that particular project.

It is our view there are a number of reasons why corporations should be actively engaged in impact mitigation. First of all, we believe there is a direct benefit to the project in terms of productivity. Studies in other areas have shown that when boomtown conditions occur, productivity declines even for individuals living in the same community who do not change jobs. Hence, there is a benefit in terms of increased productivity to corporations who are willing to spend effort and money on impact mitigation.

A second consideration is that to attract and hold the work force, adequate and ample housing and other community services and facilities must be available. We believe that attracting and holding work force is going to be a major concern, particularly of projects located in more remote and rural areas. Hence, it is important for corporations involved in synthetic fuel development to give appropriate attention and financing to impact mitigation strategies.

We believe it is important for corporations to preserve or enhance the quality of life in these areas in order to improve the relationship with local citizens, local government units, and also for the benefit of their own work force.

It is possible to reduce delays and insure the timely and cost-effective completion of projects if we are willing to provide the attention necessary to deal with socioeconomic impacts.

The Colony project, as I said earlier, has developed its impact mitigation program over a period of time. There are a number of objectives that have guided us in the development of our impact mitigation program.

First, we have sought to minimize the adverse impacts of development upon local communities and local citizens. Second, we believe it is important and necessary to provide housing and community services for the total population associated with the project. Third, we are attempting to reduce turnover, improve productivity, and reduce the potential for delays that may be associated with the project. Fourth, we have sought to cluster development in order to minimize sprawl and reduce impacts on local jurisdictions.

As the Colony project has developed its impact mitigation program, there are two major elements of that program. The first is the development of Battlement Mesa, a new community being built on 3,000 acres of land across the Colorado River from the town of Parachute. The housing densities planned for that community will eventually provide housing for up to 24,000 people. This is considerably larger than the impact that will be associated with the Colony project.

Our reason for planning a community of this size is to provide additional housing for the secondary work force that may come into the area, and also to make sure that there is adequate housing and other facilities available should the work force numbers that we have projected turn out to be larger than we have anticipated.

We have projected the development of about 8,000 housing units. For Battlement Mesa, and today there are about 700 housing units available. We are constructing apartment units, construction of single-family housing has begun, and a number of mobile home units for families and single-status workers are in place. The population of Battlement Mesa is now about 2,000 people.

In addition to providing housing, we are also providing necessary infrastructure for the local community. As we have proceeded with the development of Battlement Mesa, it has been our intention not simply to provide infrastructure for Battlement Mesa, but also to benefit neighboring communities as well.

For instance, the regional sewage treatment plan not only handles the sewage generated by Battlement Mesa but we have entered into an agreement with the town of Parachute to treat sewage generated by that community as well. We are also working with the town of Parachute on other infrastructure being developed for Battlement Mesa to coordinate our efforts.

A third area of concern is the availability of community services and facilities in Battlement Mesa. We are constructing of a new fire station and facilities for the county sheriff's department, and plans are underway for other kinds of services that will be necessary.

Under construction now is a community recreation center, costing some $6.5 million. It will include an olympic-size swimming pool, gymnasium and other facilities for the community. The facility will be made available not only to employees of the Colony project but also to residents of Battlement Mesa and the Parachute area.

In addition to the infrastructure, we are concerned to see that adequate commercial facilities are available in the area. The town of Parachute in the 1980 census had a population of about 350 people. Obviously, there is a need for expanded commercial services in the area. We are providing for the development of a commercial sector in Battlement Mesa that will include the largest supermarket on the western slope of Colorado, plus other retail shopping service facilities, and other office space.

The main reason for the development of Battlement Mesa is to provide a community that will absorb a substantial portion of the Colony project's impact in order to minimize the effect on existing communities.

The second major element of the Colony impact mitigation program is to assist and work closely with existing communities and local government units. As an example, let me cite for you our efforts with the Parachute School District, the town of Parachute, and Garfield County.

We have worked closely with the Parachute School District, which will have and has had a substantial increase in the number of students. The Colony project is financing the construction of the first new elementary school in the area, which is being built in Battlement Mesa and will be opened this fall.

We are also working with the school district to provide financing for the construction of a new high school to be started this summer.

The town of Parachute has felt a number of impacts and we are working with town officials to deal with those impacts. We have made substantial cash contributions to the town for police and administrative salaries, provided a new fire truck for the community, contributed to the construction of the new town hall, and are working on other projects of concern to the town.

We have also worked with the Garfield County commissioners to provide funds for additional police protection, expanding personnel in the county planning department, and for human services programs.

This is a summary of the efforts we have made to deal with the impacts that the Colony project is having in western Colorado.

We believe that there is a Federal role and responsibility as well in dealing with impacts of large-scale energy projects. Proper impact mitigation requires cooperation between Federal Government agencies that may be involved in synthetic fuels development and State and local governments who are on the front line in facing impacts. We believe that the cooperation of the industry is also necessary and essential.

A program of Federal assistance would be a key factor in the appropriate and timely development of our domestic energy resources. At the least, the Federal Government should reverse tax and other policies which hinder development or discourage impact mitigation. We would encourage the Federal Government to look into these issues and take action as appropriate.

Thank you very much, Mr. Chairman, for the opportunity to make this presentation.

[The prepared statement of Dr. King follows:]

STATEMENT OF DR. ROBERT R. KING
TOSCO CORPORATION
BEFORE THE
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
OF THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY
REGARDING THE
SOCIOECONOMIC CONSEQUENCES OF THE ESTABLISHMENT
OF A SYNTHETIC FUELS INDUSTRY
April 28, 1982

A. Introduction

Mr. Chairman, my name is Robert R. King. I am Manager of Community Development and Socioeconomic Planning for Tosco Corporation. Founded in 1955 as The Oil Shale Corporation to develop and license a process for converting oil shale into petroleum liquids, Tosco has developed the TOSCO II processing system. In the 1960's the Corporation, with a number of other partners, put together the Colony Shale Oil Project. Tosco today is a 40-percent owner of the Colony Project.

In the summer of 1980, Exxon Corporation acquired a 60-percent share of the Colony Project. Field construction is advancing rapidly. The Project is designed to produce 48,000 barrels per stream day of hydrotreated shale oil, as well as associated by-products. Start-up is scheduled for 1986.

In addition to the Colony Project, Tosco is developing the Sand Wash Shale Oil Project in Utah's Uintah Basin. This Project, on state leases, will be roughly equivalent to the Colony Project in scope.

As Tosco Corporation began developing the engineering for the extraction of oil from shale, it became obvious that a large work force would be required for the construction and operation of such a project. In the early 1970s in its planning for oil shale development, Tosco began to analyze the socioeconomic impacts of such a development and to develop impact mitigation strategies. As we have begun the construction of the Colony Project, this long term planning and study of other impacted areas have been the basis for the Colony impact mitigation program and our socioeconomic planning for the Sand Wash Project.

B. The Nature of the Impact Problem

The basic socioeconomic problem which results from large-scale energy development is the tax lead time issue. That is, the demand for public services and facilities exists before the direct and indirect revenues from a project are available to local government jurisdictions. A major new energy facility can double or triple the population of a small rural community in less than two years. The services and housing in most rural communities in which the majority of energy development is likely to occur in the next decade is so inadequate to meet the needs of the incoming population that comprehensive new development is required.

A rural community of 1,500, for example, could be faced with the need to plan, design, implement and manage the development of a city in excess of 8,000 people almost overnight. While major new energy facilities often double or triple the local tax base (provided there are no jurisdictional problems concerning the taxing authority), the major expenditures required for community development must be made and largely completed before the plant is operational.

There are a number of factors which distinguish energy-related growth in rural areas from more easily handled "normal" growth and urbanization. Set forth below are factors which make local funding, primarily through bond issues, an impractical solution and which create a need for federal, state, local, and industry cooperation in mitigating impacts.

- Uncertainty: The timing of development often seems uncertain due to changes in project economics and financing, changes in state and federal policy, and the possibility of court action. The unpredictable nature of development increases the risk of initial investment in community facilities.

- Magnitude of the Development: In many rural areas raising significant funding to expand the existing school system to meet the needs of the existing population often proves difficult. Thus, it is understandable that raising public funding necessary to construct an entire new community -- including water, sewer, road improvements, schools, and other services -- for a still hypothetical and contingent new population is, without assistance, out of the question.

- Pace of Development: Unlike long term, "normal" growth, energy-related growth occurs suddenly and progresses rapidly, frequently with a major impact in the first few years of development. The small rural communities involved often have experienced stable or declining populations for many years preceding development, and are thus ill-prepared for the sudden surge of growth.

- Temporary and Fluctuating Nature of the Growth: During the construction period of a major energy facility, there are generally significant peaks and valleys of population influx, and the permanent operating force is often smaller than the construction force. The communities in the area, therefore, must prepare to deal in a flexible manner with a temporary construction work force bulge in order to avoid substantial excess capacity during the operating phase.

- Condition of Existing Municipal Services and Facilities: Unlike major metropolitan areas, rural communities in many cases require entirely new facilities, extensive expansion, and replacement of existing facilities. For the most part, those services and facilities which do exist have little capacity or elasticity, and their condition is such that replacement is frequently required. In addition, the isolated location often results in higher construction costs and, because new facilities are perceived to benefit primarily newcomers and transients, there is reluctance to assume new debts prior to the certainty of new revenues.

- Frontend Financing: Significant expansion and new construction of services and facilities generally must occur during the first few years of project construction, before a sufficient tax base has been established. The frontend financing problem is usually one of timing rather than of a long term shortfall, since the increase in public revenues in most cases will ultimately exceed the total cost of expanding local government services and facilities. That the problem is one of timing rather than net loss in the long term, however, does not make it less severe. In addition, providing operating capital for the early years of the impact cycle may be as serious a problem as financing capital in place.

- Jurisdictional Problems: In addition to the problem of timing, the new energy facility with its increased tax base may be located in a different political subdivision and special districts from the population associated with the project.

C. The Corporate Responsibility

Tosco believes that it is the responsibility of corporations developing synthetic fuel and other large scale energy projects to plan for and mitigate socioeconomic impacts. It is our belief that this serves the economics of such projects. Important benefits which result from socioeconomic impact mitigation programs include:

- Productivity: Studies of other impacted areas have indicated that productivity, even of workers employed in on-going projects in the area, declines if boomtown circumstances are not mitigated.

- Attracting and Holding Work Force: Suitable attention to socioeconomic impacts makes the attracting and holding of the construction and operations work force much easier. Labor turnover can be a serious problem for any large-scale energy project, and attention to socioeconomics will frequently reduce difficulties in this regard.

- Preserving the Quality of Life: If not effectively managed, the socioeconomic impacts associated with large energy projects can have the most direct visible and dramatic effect on the quality of life in the area and are extremely difficult to correct. Advance planning and growth management in close collaboration with local and state governments insure the preservation and often enhance the quality of life in the area and it is far less costly and more effective than remedial action to correct early lack of attention to the problem. In addition, if handled properly, growth management, reduces sprawl and strip development, thus minimizing the unnecessary use of water, agricultural lands, energy resources and wildlife impacts.

Appropriate attention to socioeconomic impact mitigation measures, therefore, can reduce delays and ensure the timely and cost-effective completion and operation of major energy projects, as well as enhance the long term quality of life in the area.

D. The Colony Shale Oil Project Impact Mitigation Program

In the development of the Colony Project, Tosco has been strongly committed from the beginning to mitigate the socioeconomic impacts of the Project in collaboration with local officials. The current estimate of the peak construction work force required to build the Colony Project and related community development is 7000 employees in 1985. This figure includes workers building the Colony Project, the phasing-in of permanent operations employees, and the construction work force required for the development of Battlement Mesa. The long term operations work force for the Colony Project will total over 2,000 persons. Including family members and secondary jobs generated to serve this population, the permanent work force of 2,000 is expected to generate a total population in the area of some 14,000 people.

From the very beginning of the planning for the Colony Project, Tosco has taken the lead in analyzing socioeconomic impacts and developing an impact mitigation program. The objectives of the Colony Impact Mitigation Program are:

- To minimize adverse impacts on existing communities of growth associated with the Colony Project;
- To provide housing, community services and other facilities for the total population associated with the construction and operation of the Colony Project;
- To reduce worker turnover, improve productivity, and reduce the potential for construction delays, thus contributing to the efficient construction and operation of the Colony Project; and

- To cluster development in order to minimize sprawl.

The two main elements of the Colony Impact Mitigation Program are the development of the new community of Battlement Mesa and the Program of Assistance to Existing Communities and Other Local Jurisdictions in the Colony Project area.

Battlement Mesa

Battlement Mesa has been designed to accommodate a population of 20,000 - 25,000 people. This is considerably more than the total anticipated population associated with the Colony Project. The design provides the flexibility to handle additional population associated with the Colony Project should that be necessary, and to assist in absorbing the cumulative impacts of other shale oil development in the region. Concentrating development in a new community will significantly reduce the pressure on existing communities in the Colorado River corridor.

Battlement Mesa is an open community in which anyone may choose to live. Development is being undertaken on a non profit basis, but otherwise the community is being developed in the same manner as a commercial real estate project in order to maximize responsiveness to actual market needs. Battlement Mesa is in no sense a company town.

An overall master plan for Battlement Mesa was developed by the Denver planning firm of Harmon, O'Donnall and Henniger in the mid 1970's. The plan includes single and multi-family residences and a full range of municipal and commercial services and facilities. Among these are commercial centers, nine schools, churches, parks, open space, recreation facilities, public buildings, office buildings, a golf course and other amenities. The phased development schedule is designed to ensure the timely delivery of housing and community facilities and services to satisfy the needs of the growing population generated by the Colony Project.

Cooperation with Local Communities

From the outset, Tosco and the Colony Project have sought to provide impact assistance and to develop a positive working relationship with counties, communities, special districts and other units of local government in the Project impact area. Colony has provided to these communities information and technical assistance, as well as substantial financial assistance. A constant goal has been and will continue to be to encourage effective planning and thus to enhance the quality of life throughout the area.

During the last year alone, Tosco and the Colony Project pledged or provided funds totaling over $4.5 million to local jurisdictions. Much of this funding has been provided to the town of Parachute, which is located just across the Colorado River from Battlement Mesa; to School District Re-16, which includes Parachute and surrounding areas, and to Garfield County.

Among the specific examples of assistance is the Colony Project's financing of the construction of the Underwood Elementary School at a cost of $3.9 million. As tax revenues from the Colony Project grow, the school district will eventually repay the cost of construction without interest. The Colony Project also provided funds for assisting in the construction of a new Parachute Town Hall, for connecting the town of Parachute with the Battlement Mesa regional sewage treatment facility, and for salaries and administrative expenses for the Parachute town administration and police department.

Tosco has contributed funds to Garfield County to assist with architectural fees for an addition to the Garfield County Courthouse and the Colony Project has given funds for salaries, benefits and equipment for five new sheriff's deputies, and for salaries in the Garfield County Planning Department.

E. Federal Government Role

Orderly and economical resource development at the lowest possible social and environmental cost is facilitated by the federal government's cooperation with industry and with state and local governments in the assessment and mitigation of socioeconomic impacts. A well-designed program of federal impact assistance could be a key factor in the timely and efficient development of domestic energy. At very least, to encourage the timely achievement of the nation's energy potential, the federal government should reverse existing tax or other policies which hinder prudent and orderly development.

Mr. Fuqua. Thank you very much, Dr. King.

Mr. Sights, we will be pleased to hear from you and Henderson, Ky.

[The biographical sketch of Mr. Sights follows:]

BIOGRAPHICAL SKETCH

Russell R. Sights
P.O. Box 716
Henderson, Kentucky 42420

Married. One Son.

EDUCATION:

Graduated from the College of Commerce, University of Kentucky, in 1968, with a B.S. Degree in Business Administration.

EXPERIENCE:

March 1982 to present: City Manager, City of Henderson, Kentucky.
June 1980 to March 1982: Executive Director, Green River Area Development District.
February 1975 to June, 1980: Assistant Director, Green River Area Development District.
August 1972 to February 1975: Public Administrator, Green River Area Development District.
May 1968 to August 1972: Department Coordinator, City of Henderson, Kentucky.

AFFILIATIONS:

Member and deacon, First Baptist Church, Henderson, Kentucky.

Mr. SIGHTS. Mr. Chairman, I appreciate the opportunity to appear before you today. I like the things that have been discussed prior to my presentation because these are things that I have not had the opportunity to be aware of other than from a reading knowledge of what some corporations are doing to solve socioeconomic impacts of synthetic fuel plants.

I am the city manager of a town of approximately 25,000 people, located in the SMSA of Evansville, Ind. My remarks will center on what will happen in our area if one, two or three synthetic fuel plants are built and will not address the issue of whether or not they are going to be built.

Our area of western Kentucky has been labeled as the possible synthetic fuel capital of the world, but I know there are several other areas which are also going to experience severe growth as a result of possible similar activities, so I don't think that our possible impacts are unique.

However, it is true that at one time within the last 18 months three different corporations planned their own separate plants within a two-county area, within 20 miles of each other.

So we were concerned about impact. But rather than wait and see what the companies were going to do, our local officials through their council of governments undertook a planning project that was funded by the Department of Energy on a pilot basis to determine the impact in advance, We believed, and still believe, that officials at all levels of government, local, State and Federal, cannot wait until construction begins on any of these facilities to plan and prepare for them. Thus, the local officials in our area have been addressing the impact through its council of governments.

The critical socioeconomic impacts will be felt during construction, as has already been indicated here today, and will diminish and maybe even be nonexistent during the operational phase of the plants.

When you consider supply and demand for labor and where that labor is coming from, residential choice locations, impact on housing types and construction, highway capacity for commuters, the possible delivery of coal, et cetera, the possibility of having to have shuttle systems and park and ride lots to solve this kind of transportation problem, you begin to realize the adverse ramifications that can come about if they are not dealt with early.

Fiscal impacts caused by construction and expanded labor forces also must be dealt with, and this is of tremendous concern to us in Kentucky because of the fact that property taxes are not levied on the front end as it stands right now. Our State has considered the possibility of enacting legislation that would require this. There are constitutional problems with that idea, but serious consideration has been given.

While we recognize private companies will pay a great deal in property taxes if these plants are built, we have not been able to come up with any kind of front-end financial alternatives in terms of a governmental requirement. I commend the activities of TOSCO and Union Oil for their foresightedness and for option on their part to deal with the problems that they themselves are causing. However, that is not a requirement. They are doing that out of the goodness of their corporate hearts, and I think we need to recognize that as a fact. All companies will not respond similarly to such condition. Rather than bear this front-end cost they will look back to local governments, State governments, and to you to solve some of the problems that will be associated with it.

In addition to that, even if we solve the front-end taxing problems and the payment of property taxes in advance, jurisdictions like the one they represent will not receive any of the tax revenue benefits because these plants will be built outside of our governmental jurisdiction. Yet, my city and the city that I serve will be impacted by the negative aspects.

Whenever the cumulative impact of two or more plants is dealt with, we realize that the situation is even more adverse than I have discussed here today.

I guess in summary, Mr. Chairman, I must come from a little bit different point of view because what we have seen here this morning has been the positive impact in terms of the way the companies have dealt with the factors that exist whenever they go into a community. I am sure that many future debates will be held in these halls, and in State legislatures, and in city council meetings, and by citizen groups on the best way to solve these kinds of problems.

There are really three lines of thought. One is that this is the complete responsibility of the private sector based on supply, demand and economics. Another one is that this type of involvement is necessary on the part of the Federal Government but only to the extent that it be handled through the Synthetic Fuels Corporation. And then there is a third train of thought shared by many that the solving of these kinds of problems requires a total commitment on the part of the Federal Government if this country is to become energy independent.

One fact remains clear and cannot be ignored. There will be in most areas adverse impacts from synthetic fuel plants. There will be positive effects, too, and those cannot be ignored. However, it should come as no surprise to you that local government cannot finance the cost of meeting these front-end charges.

As of this date it seems that the Synthetic Fuels Corporation is the only game in town. The analysis and recommendations made by the staff of that Corporation on each project being considered for approval should adequately address effective mitigating measures for socioeconomic impacts and insure that the financial resources are available to meet these identified needs from whatever the source.

There may be many solutions considered in solving our energy questions, and I am sure that there will be. We would request and hope, Mr. Chairman, that local government and its citizens will not be ignored in the process.

Thank you.

[The prepared statement of Mr. Sights follows:]

REMARKS OF RUSSELL R. SIGHTS, CITY MANAGER
CITY OF HENDERSON, KENTUCKY
FOR DELIVERY TO
COMMITTEE ON SCIENCE AND TECHNOLOGY
APRIL 28, 1982

My name is Russell Sights. I serve as City Manager of Henderson, Kentucky, a community of 25,000, located in Henderson County. Our city is part of the Evansville, Indiana S.M.S.A.. My comments and remarks will not be made in terms of whether or not synthetic fuel plants will be built in our area, but will address the socio-economic impact on our area assuming that one or more plants are built in Northwestern Kentucky.

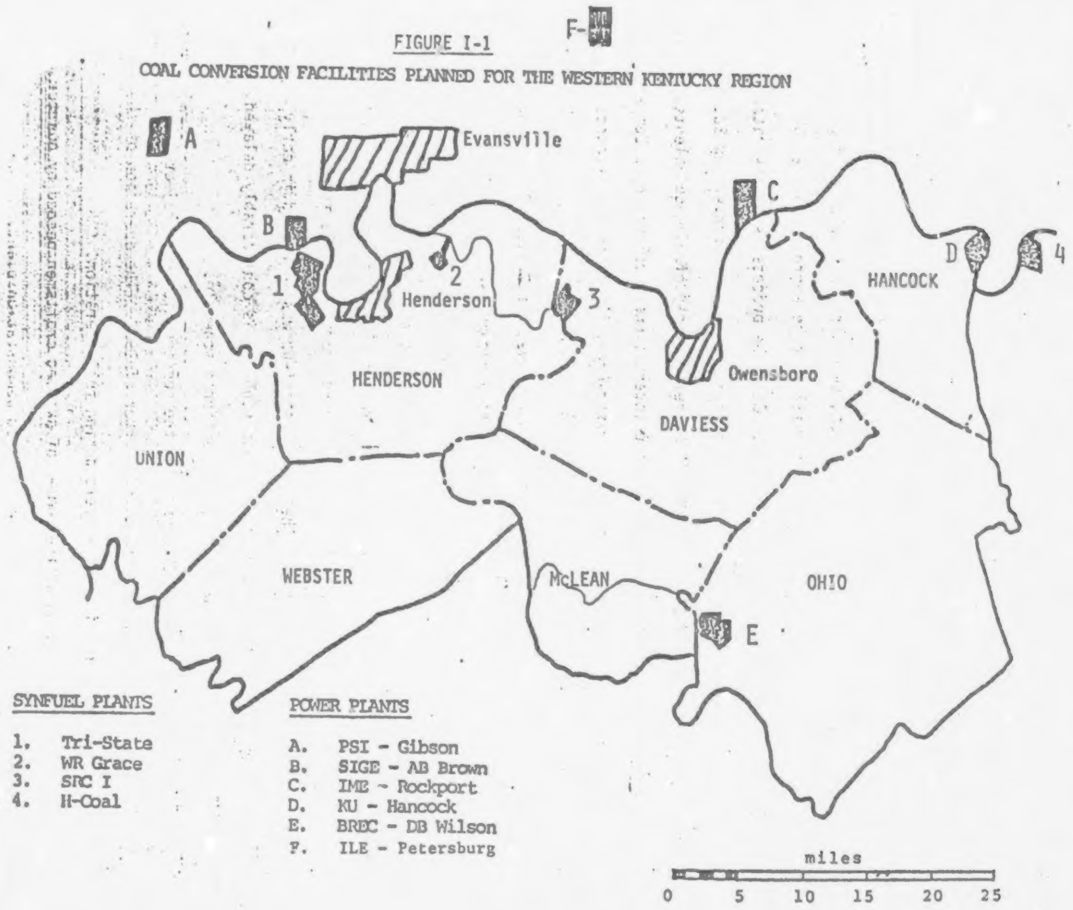
Henderson County is one of seven (7) counties that make up the Green River Area Development District (GRADD). GRADD is a regional Council of Governments containing twenty-seven (27) cities and 199,048 people. I had the opportunity to serve as Executive Director of this agency from June 1980 thru February, 1982. During my tenure, this agency was awarded funding from the United States Department of Energy to gather data and analyze the impact of synthetic fuel activites on our area.

This area of Kentucky has been labeled as the possible future synthetic fuel capitol of the country because three different corporations have announced plans for the construction of three separate synthetic fuel plants in two of the seven (7) counties. (See Figure I-1). Tri-State Synfuels and the W.R. Grace Company have both considered construction in Henderson County and the International Coal Refining Company has announced plans for a Solvent Refined Coal (SRC-1) plant in Daviess County.

On April 13, 1982, the Tri-State Synfuels Corporation announced a delay in their proposed activities until a more favorable economic or political climate emerged. At this time, no one knows whether one, two, three or any plants

FIGURE I-1

COAL CONVERSION FACILITIES PLANNED FOR THE WESTERN KENTUCKY REGION


F-
A
Evansville
B
C
1
2
Henderson
3
D
4
HANCOCK
Owensboro
HENDERSON
DAVIESS
UNION
WEBSTER
McLEAN
OHIO
E
miles
0
5
10
15
20
25

SYNFUEL PLANTS

1. Tri-State
2. WR Grace
3. SRC I
4. H-Coal

POWER PLANTS

A. PSI - Gibson
B. SIGE - AB Brown
C. IME - Rockport
D. KU - Hancock
E. BREC - DB Wilson
F. ILE - Petersburg

will be constructed in our region. However, responsible local, regional, state and federal officials cannot wait until construction begins on any of these facilities to plan and prepare for the potential socio-economic impact and consequences on any area if there is a possibility of this activity becoming an actuality. Thus, local elected officials in our area have been addressing the impact of synthetic fuel facilities through its Council of Governments for the past eighteen (18) months.

The critical socio-economic impacts from the proposed synthetic fuel plants will be felt during the construction period, and will be greatly diminished and possibly be non-existent once the plants are in operation. The following concerns have been addressed as a part of this planning effort:

a.) Supply and Demand for Labor by various classifications and crafts. An analysis must include available local supply of labor plus the number of workers that must be brought in from outside the area and relocate on either a temporary or permanent basis. Depending on the size of the facilities being constructed, peak construction activities can bring in a minimum of 3500 workers a day to possibly a maximum number of 6000 workers a day.

b.) Residential location choices.
Many construction workers will commute into and out of the area on a daily basis. Others will require rental homes, apartments, or rooms on a weekly basis lasting from a minimum of probably three months to a maximum of three years. The last group of workers will be interested in purchasing homes for the duration of the construction project.

c.) Impact on Housing types and housing construction.

Existing vacancy rates for rental units and ownership units must be analyzed in determining the alternatives available for the housing of construction workers.

d.) Effect on Highway transportation systems.

Many factors must be included in analyzing the impact on transportation systems. Highway capacity for commuting workers is one factor, parking facilities for the workers is another, shuttle systems and park-and-ride lots are still another alternative.

In addition, the transportation alternatives for shipping coal must be a primary consideration in analyzing transportation impacts. Most commercial synthetic fuel plants will use approximately 28,000 to 30,000 tons of coal in a twenty-four hour period. The impact of moving this coal by land, rail or water will be a significant factor in determining impact on these systems and the citizens of a community.

e.) Fiscal impacts caused by construction and expanded labor forces.

Property tax revenues levied on a plant will not be paid in advance, and thus cannot be used to provide the front-end financing of improvements. In addition, construction workers will demand additional services in the form of police protection, fire protection, solid waste collection, etc. and this secondary impact will be placed directly on local government.

f.) Phsyical impacts on public and governmental facilities. The main concerns in this area will consist of the capacities of water treatment plants, sewer treatment plants, schools, sanitary landfills, etc.

g.) Increased demand and impact on emergency medical, hospital facilities and mental health programs. Traffic accidents and construction related injuries will cause increased pressure on emergency medical facilities, emergency rooms, out-patient facilities and hospitals. The availability of emergency medical technicians, paramedics, medical doctors in emergency rooms, and the kinds of acute care facilities available in a general area must all be considered in analyzing capacities of these systems. Mental health programs can be impacted because of workers experiencing stress, alcoholism and other pressures.

At this point, the cumulative impact of two or more plants has not been seriously addressed because complete information is not available from the corporations, and funding resources have not been made available to local governmental bodies for this type of in-depth analysis:

FUTURE ACTIVITIES, NEEDS AND CONCERNS:

Local elected officials, appointed administrators, state officials and the citizens at large must not be shortchanged in the process of meeting our future energy needs. Individual communities must not be expected to bear the financial costs resulting from the construction of synthetic fuel facilities.

Many future debates will be held in these halls, by state legislatures, by local government bodies and by various citizens groups on what involvement is appropriate, or not appropriate, for the federal government to undertake in meeting the demand for alternate energy resources in this country. Some say these activities should be the complete responsibility of private enterprise based strictly on supply, demand and profits. Others say that the only type of involvement and support by the federal government should come from the Synthetic Fuels Corporation only, and be limited to loan guarantees and price supports to industrial corporations. Finally, many officials and industrial supporters of synthetic fuel activities say that a total commitment on the part of the federal government is necessary to create energy independence in this country.

One fact remains clear and should not be ignored! When synthetic fuel plants are constructed through whatever method and resources, local communities will be adversely impacted and affected. There must be planning in advance of construction to prepare for the socio-economic impact of these facilities and it would be necessary to implement the strategies developed and prepare for this impact with financial resources.

It should be no surprise that local government cannot finance the multitude of activities associated with actual synthetic fuel plant impacts. Resources must be made available directly from either the federal government or private enterprises who actually construct these facilities. To disregard this inevitability is comparable to misleading and deceiving local elected officials and their citizens.

As of this date, the Synthetic Fuels Corporation seems to be the "only game in town." The analysis and recommendations made by the staff of this Corporation on each project being recommended for approval should adequately address effective mitigating measures for socio-economic impacts, and insure that the financial resources are available to meet the identified needs, regardless of the source.

In the future, it is anticipated that many alternatives for financing synthetic fuel developments will be considered by the President, the Congress, private corporations and citizen groups. There may be many solutions considered in solving the energy dependent question in order to make this country independent from outside sources.

Local government and its citizens must not be ignored in the process of reaching this goal.

Mr. FUQUA. Thank you very much, Mr. Sights.

Dr. King, you are manager of community development and most of your activities are north of Grand Junction, Colo., and you live in Boulder. Is there a reason for that?

Dr. KING. My responsibilities are not limited to the Colony project. TOSCO Corporation is also in the process of developing a shale oil project in Utah and I am involved in that project as well.

Mr. FUQUA. I was just curious because it is a pretty good hike.

Dr. KING. There are good plane connections.

Mr. FUQUA. I understand, Mr. Randle, you live in Grand Junction?

Mr. RANDLE. That is correct, Mr. Chairman.

Mr. FUQUA. There were comments made by Dr. King about the Federal role. You speak of a well-designed program. What does this mean?

Dr. KING. The Federal Government, through various agencies, has indicated a concern with socioeconomic impacts, but at present there is no Federal program in place to address these impacts. Legislation has been introduced in both the House and the Senate which would provide tax deductions for prepayment of severance tax, prepayment of property taxes and other mitigation expenditures in the year these expenditutes are made. This is one area where I think the Federal Government might well act to reduce barriers to encouraging corporations to contribute to impact mitigation.

Furthermore, the Synthetic Fuels Corporation is not permitted to provide any assistance for community development areas. The loan guarantee that TOSCO Corp. has received does not permit any of the funds coming from the Federal Government to be used for community development or impact mitigation. It is our feeling that a change in this policy would be useful.

Mr. **Fuqua**. What difference do you see between western projects such as the one you are involved in and, say, the eastern projects that maybe would affect a State like Kentucky, where it is more populated with probably smaller communities within the vicinity?

Dr. **King**. In Kentucky and the Eastern United States there is a higher population density; hence there may be fewer problems bringing in a work force. In these areas, it may not be as necessary to provide infrastructure and housing that are required in the West, for example, where population is much smaller.

On the other hand, in the East in order to spread the impact over a larger area, a larger portion of funds must be devoted to improving highways and transportation links.

Some of the same problems will occur because eastern communities where some of this development is taking place are small communities ill-prepared to handle a large population influx.

There may be some shifts in focus between East and West that may be required, but the population associated with synfuels projects is substantial. The Colony project alone, for example, will have a construction work force peak of about 7,000. The long-term operation work force will be just over 2,000. Thus even areas that have higher populations, as you find in Kentucky and other areas in the East, will suffer substantial impacts.

Mr. **Fuqua**. Mr. Randle, you mentioned in your slide presentation what the Union Oil Corp. has done for housing and so forth, and I think the TOSCO project is located in the general proximity to Parachute.

Mr. **Randle**. That is correct.

Mr. **Fuqua**. Have you been able to interface together with the TOSCO project so that there is not a duplication of efforts for schools, or for hospitals, or emergency services, or housing? What if their people move over into your housing?

Mr. **Randle**. As of the moment we are maintaining our housing for employees of our project. But I think the school on Battlement Mesa is one of the examples of coordination. The school district which serves the town of Parachute also encompasses both of the plants and includes the area of Battlement Mesa. The school district has a school construction plan which calls for building most of their new schools in Battlement Mesa. The Colony project is assisting with the financing of the elementary school. The Union project is assisting with the financing of the middle or the junior high school. I don't believe there has been any duplication by the projects to date, and we certainly would do everything we could to avoid it. There is no economy in spending money for duplicate services.

Mr. **Fuqua**. Do your two projects, the people, the managers or somebody at the management level get together with the local people to discuss what needs to be done and what you may do and what they may do, like building a road around the city?

Mr. **Randle**. There has been nothing formalized in that regard. The county commissioners have assumed the responsibility for coordinating the whole effort, through their planning department. The county planning department has a position called "impact coordinator." The person in that job has been responsible for most of the coordination effort. There are no formalized periodic meetings or anything of that nature.

Mr. FUQUA. What do you think is the appropriate Federal role if there is any?

Mr. RANDLE. We have struggled with that question for several years, as I am sure you are aware. During the debate of the Energy Security Act last year, it seems as if the Congress determined that energy security is a national objective. On the other hand, that Act did not contain a method to deal with the social problems that meeting the energy security goals might be if you lived in Garfield County, Colo. If some degree of energy independence is a national goal, I think that goal has to include dealing with the special problems in the areas where energy is developed. I have no specific recommendations, but philosophically it seems to me like there is a whole package that has to be put together.

Mr. FUQUA. Mr. Sights, what experience have you had with working with some of the synthetic fuels production companies? In your responsibilities as city manager, have you had contact, have they sent people by to see you or have you sought out some of the people and talked about some of the issues that you mention and potential impact they might have on that part of western Kentucky?

Mr. SIGHTS. Yes, sir. I have been a city manager for about 6 weeks in the town I serve. However, 2 years prior to that I was the executive director of the council of governments, and we had a working relationship with all three corporations, with officials in those concerns. We did meet on a regular basis. We were on a first-name basis. We talked about these things but we never really came to any conclusions as far as what they were going to do for our units of government in that area.

We talked about things that would be nice, like the passage of a bill providing grants at the Federal level, and that is a very easy answer to sit here and give. But yes, it has been discussed. No; there were no answers arrived at.

I think two things could be considered. Obviously, as I said, you know one very easy answer is for the Federal Government just to provide grants to the local government and that will cure all ills. But to be more realistic about it, I think the idea on tax incentives to encourage the private corporations to provide this financing would be worth consideration.

I think if you want to go one step further, with all due respect to the two gentlemen sitting at the table, it might not be a bad idea to inquire as to whether the tax incentives are there or not. I believe that the private sector should be willing to bear some of the cost burden through investments whether they want to voluntarily or not, and possibly the Congress should consider a requirement along that line, that they do participate to some degree.

Mr. FUQUA. Mr. Sights, you don't presume these companies are going to spend that money and not find some way that they can write it off their taxes, do you?

Mr. SIGHTS. No, sir.

Mr. FUQUA. I think they have tax attorneys that help provide methods that it can be deducted.

Mr. SIGHTS. I am sure that is the case.

Mr. FUQUA. That occurs under existing law.

What impact has it had—since you work for the council of governments—what impact has it had, say, in Indiana, which is in very close proximity? Has it had any impact?

Mr. SIGHTS. Of course at this point our impact is merely talked about because no one has started construction of a synthetic fuels plant.

Mr. FUQUA. There hasn't been a firm commitment yet by these companies?

Mr. SIGHTS. That is right. Three are planned.

Mr. FUQUA. They may be reluctant to enter into any kind of agreement until they know what their financing is going to be and whether they will really be able to proceed.

Mr. SIGHTS. That is true. As far as the impact of southern Indiana, the potential impact, we were surprisingly pleased to find out that the impact on labor was not going to be as significant as we thought it would be. We did an analysis of the different craft unions and the availabilities within their sectors within certain radii, you know, a 60-minute driving time and an hour and 20 minutes driving time, and we found out there was a pool of available labor.

We were only looking at one plant at a time. If you were to have two, then you would have a problem that would compound. Southern Indiana, in our case, would be impacted, yes. Especially the metropolitan area of Evansville, Ind., which is about 200,000 people. Outside of that one area, though, we don't believe there will be significant impact if there is one construction activity going on at one time. If there is more than one, then, yes, all of southern Indiana will be impacted.

Mr. FUQUA. There has been talk of a possibility of three plants.

Mr. SIGHTS. Yes, sir, within two counties.

Mr. FUQUA. Until such time as they have signed on the dotted line, I am sure they would not be as serious about entering into agreements with the county until they knew what their situation was going to be.

Mr. SIGHTS. I am sure that is the case. The point I wanted to make here was that at this point all those are still voluntary, and even though, as you mentioned, their tax attorneys will find ways to write off the cost they provide to government, I am not sure that that is sufficient incentive to require them to make that expenditure.

Mr. FUQUA. What is the appropriate role, do you think, from sitting as an executive with the council of governments, and also in your responsibilities as a city manager, what do you see as the appropriate Federal role?

Mr. SIGHTS. I believe the appropriate Federal role is to have more requirements placed by either the Synthetic Fuels Corporation or the successor to the Department of Energy if they do go out of business, or whoever the authority is at the Federal level, to require that not only the problems and needs be identified but that mitigating measures be taken to solve those problems.

As it stands right now the documents and the planning efforts that I have seen on the part of the companies in terms of environmental impact and those type activities, require them to identify the problems that they will cause and enumerate those but not to present any solutions to those problems. I think that solution also should be considered.

Mr. **Fuqua**. I am not familiar with the Kentucky law, but in my State when you get ready to impact an area you have to consult with the planning department before you can even get a permit to mine or build anything. You have to get a building permit. I am thinking of something like a shopping center when somebody plans to put in, say, a regional shopping center that has an impact on traffic. The county may require, or the city may require them to assist in road widening or other things that may have an economic impact.

I am wondering if local governments couldn't perform this through that type of procedure rather than some Federal regulation that could become very cumbersome and not really be adaptable on a variety of cases that may be involved here. For instance, we were talking about the eastern projects versus, say, those in the West where they are more sparsely populated. Do you care to comment on that?

Mr. **Sights**. Yes, sir. I do believe that the State of Florida is probably one of the leaders in this regard in terms of the requirements and the authority that it has in this area. It is true local government does have that authority up to a point. They can regulate construction; they can regulate some of the costs; they can put requirements on industry. Local bodies have appointed people who serve on planning commissions and boards of zoning adjustment, and they are frontiers in the first place. While there may be a possibility of having legislation at the local level to require certain of these improvements, being realistic about it, with motivation of companies the way they are I imagine that some of them would probably not be very cooperative.

That is only a personal opinion, but usually it is better, I have found, to have either State enabling legislation or Federal legislation to have as the authority. It is difficult in some cases even to get legislation passed at the local level. There is either not sufficient statutory authority or constitutional authority for the local government to impose those kinds of regulations and, therefore, they exceed their authority and are ruled unconstitutional in their efforts.

Your point is well taken, Mr. Chairman. I believe though in reality the effect of it would be limited.

Mr. **Fuqua**. Mr. Volkmer?

Mr. **Volkmer**. I would like to ask these questions. I know Union has been here for quite a while but not enough to go into a production phase. At the time decisions were made basically did you anticipate the amount of cost that would be involved in the socioeconomic sphere of production, making the projects?

Mr. **Randle**. I think I would have to say that the analysis of the sort of costs I described this morning were taken into account at a fairly late stage in our project.

Mr. **Volkmer**. How close would you say you came to them?

Mr. **Randle**. I don't understand the question.

Mr. **Volkmer**. You anticipated so much. You now know approximately a different figure.

Mr. **Randle**. In terms of expenditures for impact mitigation, they are essentially what we predicted they would be 1½ years ago.

Mr. **Volkmer**. Then there hasn't been a great variance. You haven't found things you did not anticipate then?

Mr. **Randle**. No.

Mr. **Volkmer**. Dr. King?

Dr. **King**. With regard to the Colony project, we have been developing the impact mitigation programs since the early 1970's. We anticipated spending substantial sums of money on community development when the plans were originally put together. Obviously, inflation factors and other things have affected that.

Mr. **Volkmer**. Discounting inflation?

Dr. **King**. I think what we have spent and what we anticipate spending are relatively close.

Mr. **Volkmer**. Now what percent would you say, on the impact mitigation being spent, as a percentage of your total project cost?

Mr. **Randle**. For the Union project it is between 10 and 12 percent for the total cost.

Mr. **Volkmer**. How much of that, though, will be refunded eventually?

Mr. **Randle**. That percentage does include housing, which is a substantial part of the total impact mitigation program. Less than half, about $24 million, was spent for housing that is saleable. The rest of the expenditures for housing were made for the construction camp which we regard as a mitigation measure. The camps presence minimizes the number of people who move into the area. The cost is not recoverable. Total unrecoverable costs are probably 6 to 8 percent of the project cost.

Mr. **Volkmer**. Dr. King?

Dr. **King**. In terms of our costs we are looking at some fairly substantial costs because we are essentially building a new community from scratch. When you consider sewer and water treatment facilities, roads, and streets, and other expenditures, costs are substantial and may run higher than 10 percent of the project cost.

A portion of those would be recoverable over time. There is some question about whether we will recover the cost of money as well as the construction costs that are involved. We do not expect that we will be able to recover the full cost of money.

We estimate that we will probably recover in the neighborhood of 70 percent of our expenditures for the construction of Battlement Mesa.

Mr. **Volkmer**. Are you treating these basically as loans, then, those parts you determine to be recoverable?

Dr. **King**. It depends on the circumstances. For example, we have an agreement with the Parachute School District that the Colony project will pay construction costs of $3.9 million for a new elementry school. The school district, however, will repay to Colony the cost of construction without interest as its tax base grows due to the Colony project.

We anticipate that it will probably be 1987 or 1988 before that $3.9 million is repaid. We do not expect recoveries from other contributions.

Mr. **Volkmer**. We have heard that your local government basically is kind of coordinating the efforts, as I understand the testimony. When the project first started developing, I doubt if either Parachute had too many local planners, et cetera, did they? Or did they not? What did they have?

Mr. **Randle**. When our project first started developing the only government in Parachute was a part-time mayor and city council. The only paid staff was a part-time clerk and an inspector for the water and sewer plant. That was in 1978. Our project underwent considerable evolution from the time we first started planning until we started construction.

The county government was fortunate to have a planner who was a very sharp person. He was able to get on top of things very quickly. During his tenure the county planning department staff grew from a one or two staff up to five. Maybe it has grown beyond that, now. This planner did the majority of the coordination for the oil shale related growth.

Meanwhile the government of the town of Parachute has grown as well. The mayor and city council are still part-time but they now have a full-time staff.

Mr. **Volkmer**. During that time did the planners, et cetera, from Union or from the project people themselves assist the county planner and others in developing the plans for the growth?

Mr. **Randle**. We worked very closely with the county people.

Mr. **Volkmer**. Who would you say basically controlled that?

Mr. **Randle**. Are you asking the company or the county?

Mr. **Volkmer**. Yes.

Mr. **Randle**. I would say the county controlled it.

Mr. **Volkmer**. The county continued control.

Dr. King?

Dr. **King**. It became very evident when people first started talking about massive oil shale development in western Colorado that impacts would be substantial.

Beginning in the early 1970's as a number of Colorado State officials, local officials in Garfield County, and neighboring counties, and some of the companies involved began studying these issues. TOSCO Corp. played a leading role in these studies to assess potential impacts and to work with local planners.

It has been our concern to make sure that local jurisdictions have trained planners. One of the things we have done is provide substantial funds to the county to provide for the augmentation of the county planning staff. We have also made contributions to the town of Parachute to permit it to hire additional administrative and planning personnel. There have been some important changes in anticipation of oil shale development in the area of planning.

Mr. **Volkmer**. Would it have been of any help, now looking back, if either Garfield County or the city of Parachute had available to them, say, loan funding, or even the school district, loan funds in order to upgrade their planning and even——

Dr. **King**. There were some grants available. Department of Energy grants were made available to the local councils of governments for planning. One of the reasons the impacts have been so well handled is that there were substantial grants in the past, primarily through the Department of Energy, and to some extent to the State to do planning before the impact actually occurred.

Mr. VOLKMER. So those were of help?

Dr. KING. Definitely.

Mr. VOLKMER. Of course, it is obvious that the amount of funds that both of you, TOSCO and Union have had to place on economic and social impacts and mitigation thereof, has not deterred you from going forward with the project.

Dr. KING. No; we are going ahead full steam.

Mr. VOLKMER. I have no further questions, Mr. Chairman.

Mr. FUQUA. Mr. Gregg.

Mr. GREGG. Thank you, Mr. Chairman.

Mr. Randle, can you tell me how the Union project is structured regarding the Federal activity in the project?

Mr. RANDLE. Are you asking about the contract that has now been assumed by the Synthetic Fuels Corporation?

Mr. GREGG. Yes.

Mr. RANDLE. That contract is really a two-part contract, and the two Federal departments involved are the Department of Defense, which has contracted to purchase 10,000 barrels a day of military fuel, primarily JP-4 and diesel, from Union Oil Co. The other Federal entity is the Synthetic Fuels Corporation. The agreement between the SFC and Union required Union to produce up to 10,000 barrels a day of synthetic crude oil. The Synthetic Fuels Corporation, in turn, will make payments to the company, if the market price of the above mentioned product drops below the market price.

To date there has been no flow of funds from the Government to the company. All of the moneys that have been spent have been Union Oil funds. All of the risks the project management takes—the technology—lie with the company. Money would only flow from the Government to the company if the project is a technical success and the price of oil has deteriorated so the market price of product has dropped below the marker price.

Mr. GREGG. What is the marker price?

Mr. RANDLE. It was set at $42.50 per barrel of product when the contract was signed.

There is an escalation formula with which I am not fully familiar; I couldn't tell you what the market price is today.

Mr. GREGG. When the project comes on line, what is the projected marker price?

Mr. RANDLE. I couldn't tell you that, either.

Mr. GREGG. What would product price be? When was the $42.50 price set?

Mr. RANDLE. The $42.50 price was set in June 1981, I believe.

Mr. GREGG. What was market price for product then?

Mr. RANDLE. The market price for product at that time was $42.50/barrel. That was the weighted average acquisition price of diesel and JP-4 by the Department of Defense.

Mr. GREGG. Is it your contention you will not be subsidized vis-a-vis the market?

Mr. RANDLE. We won't know if there will be payments by the Government to Union until we start producing.

Mr. GREGG. I find it hard to understand how you don't have a projection; you must have done pro forma projections?

Mr. **Randle**. I am not saying that the company does or does not have that projection. All I am saying is that I don't know what it is.

Mr. **Gregg**. Dr. King, under the TOSCO project, what is the company's contribution to the program?

Dr. **King**. The socioeconomic mitigation program?

Mr. **Gregg**. To your shale oil project.

Dr. **King**. TOSCO is a 40-percent owner of the Colony project, and we are now bearing 40 percent of the cost.

Mr. **Gregg**. What is your projected cost?

Dr. **King**. I am not prepared to discuss those numbers. I don't have the numbers with me today.

Mr. **Fuqua**. I might point out to the gentleman the witnesses today are really here to discuss the socioeconomic impact in the communities where these plants are built, and they are probably not in management positions where they are familiar with all the costs. They are involved really with either the construction operations and impact on local communities——

Mr. **Gregg**. I appreciate the chairman making that clear. I consider one of the impacts to be the cost that the Federal Government has to bear as a result of proceeding with these plants. I realize that may be out of their expertise, but still I would like to make clear for the record my concerns about the cost of these projects to the public. I guess Dr. King doesn't have the figures, but as I understand it, TOSCO's contribution is going to be significant in dollar terms.

Dr. **King**. Yes.

Mr. **Gregg**. But they will be receiving a dramatic tax credit which would be applied toward earnings and could also be considered to be a subsidy, and as a result their contribution to the project is not that high. Would that be an adequate assessment?

Dr. **King**. I disagree with that, but I am not in a position to discuss it intelligently with you now because I do not have those figures.

Mr. **Gregg**. I appreciate your coming and maybe we can discuss that with some other panel.

Thank you.

Mr. **Fuqua**. Thank you, Mr. Gregg, and thank you, Mr. Randle, Dr. King, and Mr. Sights.

Mr. **Volkmer**. Mr. Chairman, may I ask a question of Mr. Sights?

Mr. **Fuqua**. Surely.

Mr. **Volkmer**. About what would you consider the total funding that would be necessary in order to prepare a mitigation—socioeconomic mitigation plan for the seven-county area or whatever it is in western Kentucky?

Mr. **Sights**. Mr. Volkmer, I can give you some estimates but I guess it would depend on whether you want the Chevrolet or the Cadillac.

Mr. **Volkmer**. I will take the Chevrolet.

Mr. **Sights**. If that is the case——

Mr. **Volkmer**. What is a bare minimum?

Mr. **Sights**. The bare minimum for our seven-county area, being realistic.

Mr. **Volkmer**. And looking at a total possibility of all three projects.

Mr. **Sights**. We have not done cost figures on two of the plants so I don't feel that I ought to even estimate a figure. But just using the one plant, the solvent refined coal plant, as an example, we came up with total cost estimates required for things like transportation improvements, et cetera, it would equate to somewhere between $10 and $15 million over the full range of the project.

Mr. **Volkmer**. How much would it cost to just do the planning?

Mr. **Sights**. I thought you meant the capital improvements.

Mr. **Volkmer**. No.

Mr. **Sights**. I can relate to that a lot better. Whether it turns out to be three plants or five, a lot of your work once it is done one time does not have to be repeated. Some has to be updated, but you don't have to go back and plow the ground again. I think a realistic planning figure that would probably run a minimum of 2 to maybe 4 years would be somewhere in the area of a half billion dollars over the full run of the project. Not that much per year. That would be the total.

Mr. **Volkmer**. Thank you, Mr. Chairman.

Mr. **Fuqua**. Thank you, Mr. Volkmer. Thank all of you, gentlemen, for your time and your comments this morning. Thank you very much.

Mr. **Fuqua**. Our next witnesses will be Mr. Randal H. Ihara, executive director, Office of Policy and Evaluation, Kentucky Department of Energy; Mr. Steven Gottlieb, director, Environmental and Socioeconomic Impacts, U.S. Synthetic Fuels Corporation; and Dr. Susan L. Carpenter, associate director, ROMCOE, Boulder, Colo.

We will begin with you, Mr. Ihara.

STATEMENTS OF RANDAL H. IHARA, EXECUTIVE DIRECTOR, OFFICE OF POLICY AND EVALUATION, KENTUCKY DEPARTMENT OF ENERGY, LEXINGTON, KY.; STEVEN GOTTLIEB, DIRECTOR, ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS, U.S. SYNTHETIC FUELS CORPORATION, WASHINGTON, D.C.; SUSAN L. CARPENTER, ASSOCIATE DIRECTOR, ROMCOE, BOULDER, COLO.

[The biographical sketch of Mr. Ihara follows:]

Randal H. Ihara

Randal H. Ihara is the Executive Director of the Office of Policy and Evaluation of the Kentucky Department of Energy. He holds a Ph.D. in political science from the University of Tennessee and has been with Kentucky's energy program since 1975. On May 17, 1982 he will join the staff of the Democratic Policy Committee of the U.S. Senate.

Mr. **Ihara**. Thank you very much, Mr. Chairman. I am sure you are aware of Kentucky's interest in the development of the synthetic fuels industry. The Commonwealth's commitment, as a background, began in 1972 and has flourished under three governors. Under their leadership Kentucky has assumed a leadership role in State-supported research, coal research and development. And from the beginning of this effort about 10 years ago, Kentucky has committed over $100 million to the development of a coal-based synthetic fuels industry in the State, and we are now at an important juncture in this enterprise.

There are four coal-based synthetic fuels projects that are being proposed for the western part of the State, and these projects are all at varying stages of development and are reaching critical decision points. For example, a commercial scale H-coal liquefaction project proposed for Breckenridge County is currently being evaluated as a candidate for financial assistance under the Synthetic Fuels Corporation's solicitation.

The project would convert 22,000 tons of coal per day into about 51,000 barrels per day of refinery feedstocks and fuel oils. The W. R. Grace Co. is proposing a plant in Henderson County, a 50,000 barrel a day, indirect coal liquefaction project currently in the preliminary design and assessment stage, and would convert about 28,000 tons of coal per day into unleaded gasoline.

The project proposers have submitted a preliminary proposal for loan and price guarantees to the Synthetic Fuels Corporation.

The third project was initially designed to convert 28,000 tons of coal into 50,000 barrels per day of liquid transportation fuels, pipeline quality gas, and chemical feedstocks. It was proposed by the Texas Eastern Corp.—we refer to it as the Tri-State project—proposed for Henderson County and was at the preliminary engineering design stage when it was announced by project officials that the scaling and other aspects of the project were going to be subject to reevaluation and any further progress on that particular project depends on the outcome of that reconsideration.

The final project with which I am sure you are familiar is the SRC-1 project proposed for Daviess County. It is the last surviving project from the U.S. Department of Energy's demonstration program. It is a commercial scale module, processing 6,000 tons of coal per day into 20,000 barrels per day oil equivalent of solids, liquids, and gases.

All four of these projects are proposed for the western part of the State, in close proximity to the western Kentucky coalfields, which are high sulfur coalfields. The projects would be located within 50 miles of each other in a region of the State where there are also several conventional energy projects being constructed in Kentucky as well as in southern Indiana.

As these projects have moved closer to the final stages of development, sponsors, local communities and State government have focused attention on the socioeconomic consequences of synthetic fuels development in the State. The Commonwealth is determined to learn from the experiences, the early experiences of the Western States with the impacts of large scale energy development, and we are convinced that the now famous examples of severe impacts in the West are by no means inevitable and that they can be, if approached reasonably, addressed.

In Kentucky the location of these facilities has become a critical issue for the local communities, as you have heard from Mr. Sights. During the period of time within which these projects would start construction they will be competing for labor with four, and possibly five, conventional coal-fired electric power plants, two of which will be in Kentucky and three directly across the river in Indiana.

Substantial efforts are underway, particularly for Daviess and Henderson Counties, to address the problem, or to plan for and address the problems associated with the construction of these plants. Breckenridge County, which is the site of a fourth project, has not had local resources available at this point to address the problem of local impacts. It is important to note also that Owensboro and Henderson, which are in Daviess and Henderson Counties, are urbanized areas while Breckenridge County is largely rural, fairly isolated and its economy is basically agricultural.

At the level of State government we have formed a synthetic fuels technical committee. That has been formed to maintain an ongoing assessment of potential project impacts, especially relative to State agency programs and services. The committee is made up of representatives of appropriate State agencies. As a result, of the work of the committee, there have been two major highway improvement projects scheduled in an effort to address some of the anticipated transportation problems.

In addition, planning is underway for vocational education programs in an effort to increase the availability of welding and electrician skills if the demand for those skills develops.

Finally, the committee's analysis of projected increase in school enrollment as a result of increased population has led to the conclusion that these increases do not pose a problem for local school systems. This is mainly because no school construction would be necessary. However, State government's costs for highway improvements and for State education funding would be rather large.

The Kentucky Department of Energy is also playing a lead role in trying to develop population—a population impact model will be used in the assessment of such impacts on the western Kentucky counties. We call this model the "Kentucky synfuels impact model." It is designed to provide a uniform set of population figures for assessing synfuels development impacts and for supporting State and local planning activities.

Through the use of this analytical tool, as well as other work, we are developing baseline profiles of the social and economic characteristics of the impact area in the western part of the State, and these profiles are being maintained and updated fairly regularly and published in an effort to meet local community needs.

We also review and comment on the work of the various consultants employed by the project in Kentucky to make impact assessments. We have been most active in the effort to estimate the magnitude and timing of local property taxes which might be realized from the construction and operation of these projects. I believe you have a copy of some of the early assessments we have done and these are examples of the kinds of things we are trying to make available to the State and local communities.

I think it is also important to maintain a sense of perspective regarding the impacts of synthetic fuels projects if we are to avoid what we see as twin dangers, one being absolute negativism and the other being an uncritical boosterism. On the other hand, there are economic benefits to be realized through the construction and operation of synthetic fuels projects in Kentucky.

For example, it is estimated that the total construction employment could be as high as about 23,000 in 1987. Operation of the plants could result in direct employment as high as 5,000 jobs by 1990. State personal income tax revenues are estimated to reach a peak as high as $6 million a quarter in late 1985 and level off to about $3 million a quarter. Severance taxes from the mining of coal could be as high as almost $12 million a quarter. So we are looking at some economic benefits on the revenue side, jobs and so on. Of course, the employment impacts can be a double-edged sword.

On the other hand, there are expected to be significant population impacts to the local communities in the western part of the State. According to recent estimates the construction of three of the projects in two of the counties will create problems associated with tax leadtime and jurisdictional mismatch, which you heard Mr. Sights address. Property taxes on the projects would accrue to the counties while the population influx would fall on the cities in those counties as well as some of the surrounding areas.

In addition, we have estimated that total State and local property tax revenue from the projects would accrue about 90 percent to the State and 10 percent to the counties, so that exacerbates that mismatch, and these estimates, of course, are affected by the problem of uncertainty which also causes problems for the local communities in attempting to plan for impacts. They are faced with considerable risks in the local communities as project revenues do not materialize early enough and project schedules have and probably will continue to slip.

It is difficult to put together front-end financing, for example, for water and sewer construction, when you are not sure exactly when it will be needed. The project schedule may slip considerably, which makes it very difficult both for the local communities and the State as well.

In conclusion, I would like to say there is no consensus regarding the appropriate role of the Federal Government in socioeconomic impact mitigation, so consequently there is no Federal policy. The situation in some sense is a little ironic since the Synthetic Fuels Corporation is a key actor in the development of an industry, of course, which will generate substantial impacts in States and local communities. But absence of Federal policy in this area means there are no guidelines at a minimum for the two dozen or so existing Federal programs that could be of assistance to States and local communities in the mitigation of these impacts.

Such guidelines could redirect Federal programs such as water and sewer construction grants or rural housing loans to give greater emphasis to areas impacted by this type of energy development. The only program which specifically recognizes the problem of socioeconomic impacts is section 601 of the Power Plant Industrial Fuel Use Act, but that particular program is rather limited.

For example, the coal liquefaction project impacts would not be directly addressed by that, but any impacts from the mining of coal would be. It is the only program which recognizes some responsibility, however, for Federal impact mitigation. But as I understand it, the funding and budgetary support for that has been minimal and has been a problem.

Given the predominant mood of the current administration and the current fiscal crisis, the prospects are slim for Federal involvement in impact mitigation efforts. But the role of the Synthetic Fuels Corporation in the development of the synthetic fuels industry should be leveraged to insure that project sponsors develop and implement comprehensive, effective socioeconomic mitigation plans.

This is a minimum strategy which would require well defined and effective communications channels between the corporation, project sponsors, State and local governments and other public representatives. It would require a willingness on the part of the Synthetic Fuels Corporation to accord socioeconomic impact mitigation plans the same status they would give to plans for financing the projects and the plans for technical development, and so on.

Tax incentives we think should be provided to encourage developers of synthetic fuels projects to provide various forms of mitigation assistance to communities. Serious consideration should be given to amending the Internal Revenue Code to improve tax treatment of a company's expenses for qualified impact assistance expenditures. They could be allowed to take Federal tax reduction for prepayment of State or local taxes in the year it is made.

As Mr. Sights pointed out, in Kentucky we have a problem with that, but that is our problem that we have to work out. We recognize there is a role for the State, there is a role for the local communities, but there is also a role for the Federal Government.

In addition, impact assistance provided by project developers should be considered as normal business expenses and should be allowed to deduct those expenses in computing Federal income tax liabilities.

Mr. Chairman, that concludes my formal statement.

[The prepared statement of Mr. Ihara follows:]

SOCIO-ECONOMIC IMPACTS AND

SYNTHETIC FUELS DEVELOPMENT IN KENTUCKY

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Testimony before the Subcommitte on Energy Development and Applications, Committee on Science and Technology

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Mr. Chairman, you are no doubt aware of Kentucky's interest in the development of a coal-based synthetic fuels industry. The Commonwealth's commitment began in 1972 and has flourished under three Governors. Under their leadership Kentucky has assumed a leadership role in state-supported coal research and development. From the beginning of this effort ten years ago Kentucky has committed over $100 million to the development of a synthetic fuels industry in the state. We are now at an important juncture in this enterprise: there are four major coal-based synthetic fuels projects which are being proposed for Kentucky. These projects, all at varying stages of development, are reaching critical decision points. For example, a commercial-scale H-Coal liquefaction project is currently being evaluated as a candidate for assistance under Phase II of the U.S. Synthetic Fuels Corporation's first project solicitation. The project would convert 22,500 tons of coal per day into 51,500 barrels per day of refinery feedstocks and fuel oils.

W.R. Grace and Company has proposed a 50,000 barrel per day indirect coal liquefaction project. The project, which is currently in the preliminary design and assessment stage, would convert 28,800 tons of coal per day into unleaded gasoline. The project proposers have submitted a preliminary proposal for loan and price guarantees to the U.S. Synthetic Fuels Corporation.

The third project was initially designed to convert 28,000 tons per day to 50,000 barrels per day of liquid transportation fuels, pipeline quality gas, and chemical feedstocks. The project was proposed by the Texas Eastern Corporation and was at the preliminary engineering design stage when it was announced by project officials that the scale and other aspects of the project would be subjected to re-evaluation. Further progress depends upon the outcome of that re-evaluation.

The SRC-1 project is the last surviving project from the U.S. Department of Energy's demonstration program. It would process 6,000 tons per day of coal into 20,000 barrels per day (oil equivalent) of solids, liquids and gases. Detailed engineering for the project is currently underway. Construction of the project will depend upon the availability of federal assistance.

All four of these projects would be located in Western Kentucky within close proximity to the coal fields. The projects would be located within fifty miles of each other within a region of the state where several conventional energy projects are being constructed.

As these projects have moved closer to the final stages of development, project sponsors, local communities and state government have focused attention on the socio-economic consequences of synthetic fuels development in Western Kentucky. The Commonwealth is determined to learn from the Western states' early experiences with the impacts of large-scale energy development projects. We are convinced that the now familiar examples of severe adverse impacts in the west are by no means the inevitable consequences of energy development. Later in my testimony I will discuss the steps Kentucky is taking to address these issues.

OVERVIEW AND ISSUES

In recent years public concern has been more acute regarding the local community impacts associated with major development projects. With the advent of the "energy crisis" and the attendant surge in the intensity of efforts to develop domestic energy resources, much public attention is being focused specifically on energy development projects. Several well-known cases have illustrated (e.g., Sweetwater County, and Rock Springs, Wyoming) that such projects can induce rapid population growth in communities located near the development. The magnitude of the influx of new population can be considerable relative to the existing population of these communities. This can be especially burdensome because energy-impacted communities tend to be rural in nature, and are often ill-equipped and poorly prepared to address the consequences associated with the rapid influx of new population (urbanization), or significant changes in the local economic structure (industrialization).

The pattern is becoming familiar. Energy-impacted communities often lack the organizational and immediate fiscal capabilities to plan for and address the consequences of new development projects. As a result, the provision of public services does not coincide with the need to support new population generated by the primary force at the construction and operation phase, as well as any new population stimulated in the service and support sectors. Such requirements are often lacking and local fiscal resources required to finance the development of such infrastructure tends to lag behind the need. Existing facilities are severely strained or inadequate, which in turn impairs the quality of life in the community. Moreover, the social structure of the locality may be substantially altered, which can change the conduct of daily affairs. Such changes can alter the character and the social cohesion of the community. Indices of the consequences of such changes can include significantly higher rates of divorce, alcoholism, drug use, mental disorders, and other phenomena associated with social stress and conflict.

Energy development projects can induce conditions of "boom and bust" as a result of the pattern of labor force requirements. The dichotomy between the construction or start-up phase of a project and project operation, with their differing manpower levels and composition of skills, can pose serious problems for a local community, as illustrated in Figure I*. Typically, for example, the construction phase is characterized by a rapid buildup of manpower which also quickly drops off as project construction is completed. Thus, a large and sudden influx of money and people during the construction phase can suddenly be followed by out-migration of workers as the project is completed. As project operation begins there may be a less rapid and less intensive build-up of personnel associated with project operation.

*All figures and tables in Appendix.

Part of the problem for the local community stems from the fact that the construction phase and its attendant manpower build-up is, for the most part, transitory. Thus, infrastructure demands grow rapidly with the build-up of construction workers and then drops off as construction is completed. In contrast, the infrastructure demands associated with the influx of operating personnel are more permanent, though less intensive due to the relatively lower manpower requirements.

Unfortunately, local tax revenues generated by construction and operation of a project typically lag behind infrastructure development, i.e., revenues to finance the development of social infrastructure come after the demand has been generated. The dynamism of large energy development projects make estimation of infrastructure needs difficult at best. There is thus a danger of either overestimating or underestimating service and facility needs. If such needs are overestimated, the locality may be burdened by increased debt as a result of financing of infrastructure development. Underestimation may burden the locality with excess demand and insufficient time to expand public services. Coupled with a lack of local institutionalized planning capabilities, many energy-impacted communities can find themselves in extremely difficult circumstances.

Local capabilities for dealing with the socio-economic impacts of energy development are important not only in terms of the communities in question, but for those proposing to build and operate such projects as well. Absent concern on the part of project proposers and there is the specter that planned facilities can be subject to delay as a result of adverse local reactions manifested in court actions or other forms of resistance. Given the capital intensiveness of these projects, many in excess of $1 billion, such delays can be costly as the time for completion increases.

For the purpose of public policy, many of the sites where energy development projects could be located may entail social costs which could outweigh their benefits in increased energy production. Economic criteria, such as availability of water, proximity to feedstocks and markets might not be considered acceptable to local communities for siting projects when considered in light of perceived negative impacts on the people and communities in the host county.

A PERSPECTIVE ON SOCIO-ECONOMIC IMPACTS

It is important to develop a perspective regarding the impact of energy development projects if we are to avoid the twin dangers of absolute negativism on the one hand, and uncritical boosterism on the other. Neither is appropriate for the purposes of public policy, especially in light of the nation's long-term energy problems and the potential impacts on local populations.

Without attempting to minimize the significant problems outlined above, it is appropriate to acknowledge that host communities also experience significant economic and other benefits as a result of energy development project location. The development of local institutional capabilities is a crucial determinant of the extent to which costs are considered to be acceptable or benefits are enjoyed.

Moreover, it is important to recognize that the social, economic and other costs as well as the benefits of energy projects vary enormously from site to site, from region to region. The severity of impacts can depend upon such site-specific factors (i.e., host county characteristics) as local population size and growth rates, population density in the host county and surrounding areas, proximity to regional centers of population (for labor force services and trade), local institutional capabilities to plan for, manage, and finance necessary infrastructure facilities.

There is already a growing body of experience and literature regarding the impacts of energy development, primarily in the western United States. As a result of the rapidity and scope of energy development initiatives, the rural character of much of the West, and other factors, the impacts have been acute. With a population density of approximately 10 people per square mile, compared to the national average of about 60, many of the rural communities in the West have been ill-prepared to address the problems associated with the rapid influx of new population. A

Department of Energy report noted that of 131 western sites that were considered candidate host communities for energy projects, few had full-time planners, city engineers, or town managers. Only a third of those communities had adopted comprehensive plans which could provide guidelines for future growth, while enforcement and other mechanisms for the implementation of such plans were absent.

The severity of socio-economic impacts may depend upon a number of factors. For example, the magnitude and rate of population growth, a critical factor in determining the severity of impacts, may be diluted in terms of their local impacts in the Eastern U.S. where there tend to be more densely populated urban areas. Such areas tend to have an excess or unexhausted primary workforce and service capacity. Studies of workers at the construction phase, where most severe impacts occur, have indicated that the workforce is made up of a large proportion of young, single males who tend to migrate from job to job. In contrast, the operating workforce tends to be made up of employees accompanied by their families. Permanence is also enhanced by the higher percentage of women employees as compared to the construction workforce.

Population increases in the secondary sectors associated with the growth in the primary workforce is not instantaneous. Rather, such growth may lag behind the influx of primary workers by 2 to 3 years. Consequently, secondary population associated with the construction phase, which has short-term impacts, may be far less than the use of multipliers would lead one to expect.

There are, then, a number of factors which play a configurative role in the capacity of a region to "absorb" or "assimilate" socio-economic impacts. Vast differences in this absorption capacity exist between the Western and Eastern United States, as illustrated in Figures II & III.

There are technology-specific factors, such as the scale of the project in terms of capital and labor requirements, which play a significant role in the generation of local socio-economic impacts. Thus, for example, the capital requirements and the patterns of manpower build-up during construction and operation differ significantly for a nuclear power generating facility, a coal-powered facility, and a coal gasification or liquefaction plant. Since the "workforce" for any project is not homogenous, the pattern of labor skills and the schedule for their deployment, as well as the wage structure and other capital expenditure patterns and schedules can play a configurative role in determining the intensity and distribution of local costs and benefits. An insufficient local labor pool in any particular skill may require the importation of such skills from other areas of the country. Depending on the magnitude of the "shortage", the schedule of deployment, and other factors, this may entail costs and benefits for a community.

Thus far the discussion has referred to the local community impacts of energy development projects as a generic category, rather than to synfuels projects specifically. In large part this is due to the limited domestic experience with the construction and operation of such facilities. Although there is no synfuels industry in the U.S. today, considerable evidence and experience is available regarding the socio-economic and other consequences associated with the construction and operation of large nuclear and coal-fired plants, as well as large non-energy related development projects. This experience can provide guidance and some insight regarding the problems experienced by local communities as a result of rapid growth. However, it should be noted that synfuels facilities are projected to have two to three times the workforce requirement of major mine or power plant projects. In a known technology such as power plants workforce estimates for planning purposes have been consistently lower than actual experience.

Drawing upon this growing body of experience, as well as the larger body of literature in the social sciences on the processes of urbanization and industrialization, it is clear that the problems of growth associated with energy development are far from intractable. Indeed, the severity of local community impacts can be mitigated or avoided altogether if socio-economic and other potential impact areas are taken into account at the early stages of energy development. At that point it is particularly important that local governments begin to develop strategies and programs to address growth management problems. If local governments are to be in a position to initiate such actions, they must be apprised of the timing, scope and magnitude of energy projects planned for the area. This is by no means a panacea. It is, however, a prerequisite.

THE KENTUCKY SITUATION

1. PLANNING FOR SOCIO-ECONOMIC IMPACTS

The location of energy production facilities has become a critical issue for the local communities in western Kentucky. During the period of time within which the coal-based synthetic fuels plants would start construction, they will be competing with four, and possibly five, conventional coal-fired electric powerplants for manpower. Two of these plants are in Kentucky, and three are directly across the river in Indiana in the impact region (see Figures IV & V). There will be testimony by Mr. Russell Sights regarding local efforts to plan for impacts in Daviess and Henderson Counties. As you will hear, substantial efforts are underway, particularly for Daviess and Henderson Counties, the sites of three of the projects. Breckinridge county, the site of the fourth project, has not had local resources available to address the problem of impacts. It is important to note that Owensboro and Henderson (in Daviess and Henderson counties) are urban areas, while Breckinridge is largely rural, isolated and wholly agricultural in its economy.

At the level of state government, a "Synthetic Fuels Technical Committee" has been established to maintain an ongoing assessment of potential project impacts on state agency services and programs. The Committee is made up of representatives of appropriate state agencies. As a result of the work of the Committee two major highway improvement projects have been scheduled in an effort to address anticipated transportation problems. In addition, planning is underway for vocational education programs in an effort to increase the availability of welding and electrician skills if demand for such skills develops. Finally, the Committee's analysis of projected increases in school enrollment has led to the conclusion that such increases do not pose a problem for local school systems, largely because no school construction would be necessary. However, state government's costs both for highway improvements and state education funding would be large.

The Kentucky Department of Energy (KDoE) is also playing a lead role in developing a population impact model which will be used in assessments of such impacts on Western Kentucky counties. This model, called the Kentucky Synfuel Impact model, is designed to provide a uniform set of population figures for assessing synfuels development impacts and for supporting planning activities. Through the use of this analytic tool, as well as other related work, KDoE is also developing baseline profiles of the social and economic characteristics of a 13 county impact area in Western Kentucky. These profiles will be maintained, updated and published in an effort to meet local community needs for such data.

KDoE also reviews and comments on the work of the various consultants employed by the projects in Kentucky to make impact assessments. KDoE has been most active in the effort to estimate the magnitude and timing of local property taxes which might be realized from the construction and operation of the proposed synfuels projects.

The figures presented below are drawn from early results of the assessment. It should be emphasized that these are early preliminary estimates based upon the information received from project proposers about construction and operation schedules. Because these schedules are the basis for generating employment levels, and thus population wage and revenue estimates, changes in the schedules will significantly alter other estimates. (It should also be noted that these estimates were developed prior to the recent announcements by the sponsors of the Tri-State project that the project was being substantially altered and re-evaluated in terms of technology, size and schedule.)

2. PRELIMINARY ESTIMATES

a. Labor Force

Figure VI shows the construction labor requirements for each of the five projects and the composite total for all projects. It is estimated that total construction requirements could be as high as 25,000 in 1985. Note the rapid build-up of construction personnel and the rate of decline, particularly for the Tri-State project, which reaches a peak of about 14,000 in 1985.

Figure VII shows the composite capital construction in millions of dollars per quarter for all projects. Not surprisingly, the curve is very similar to that for composite employment. Capital construction reaches a peak of slightly more than $1 billion dollars in 1986.

Because these projects are all major users of coal, their operation will have an impact on the Kentucky coal industry. It is estimated that coal demand from all plants could reach about 9.3 million tons per quarter by late 1990 from surface and underground mines. About 60 percent of this demand would be met by surface mines with the rest by underground mines. Employment to meet synfuels demand in Kentucky could be about 9,500 by late 1990.

Direct employment as a result of the operation of the plants could be 5,000 by 1990, which, when added to mining employment, could bring total employment (excluding other service sector employment) to about 14,000 in 1990 (Figure VIII).

Figure IX shows the construction employment estimates for a number of planned conventional powerplants in the area. The close coincidence of a number of these curves with those of the synfuels plants suggests the potential for heavy demand on the construction labor pool in the area. However, the schedules for both types of facilities are highly variable and changes could either intensify or mitigate the demand. The effects of schedule changes are currently being analyzed by KDOE.

b. Economic and Revenue Estimates

Wages earned by construction workers could reach a peak of about $157.6 million in the third quarter of 1985, while wages for operating personnel rise to $24.4 million by the first quarter of 1990. Mining wages associated with coal production for the synfuels plants reach $51 million by the last quarter of 1990 (Figure X). By the fourth quarter of 1990, it is estimated that wages for operating and mining personnel could be $75.4 million.

State personal income tax revenues are estimated to reach a peak of $6.15 million in the third quarter of 1985. Income tax revenues would be $16.2 million for the year. The cumulative total income tax revenue from construction, operating and mining personnel wages from 1981-1990 could be $86 million. Total cumulative wages over the same period could be about $2.3 billion.

Figure XI shows construction, operating, mining wages and income tax by quarter.

Coal demand associated with the operation of the synfuels plants could reach about 9.3 million tons late in 1990 with a value of $262.7 million. Severance tax revenues would be $11.8 million (Figure XII). The cumulative value of synfuels coal demand from 1984-1990 could be about $2.5 billion, while cumulative severance tax revenues over the same period could be about $109 million.

c. Population Estimates**

The need for workers from outside the local area will be very great if all the synfuels and conventional energy projects in the region are built according to the current schedules.

** The estimates presented below are more current than the previous estimates. There will, therefore, be some discrepancies between the two sets of figures. For example, peak construction is now estimated to be 23,000 in 1987, rather than 25,000 in 1985.

Many of those workers will live near the job sites during the work week, but return to their homes outside the region on the weekends. Others will establish permanent (i.e. full-time) residences in the local area, bringing their dependents with them. In the KSI model, the former type of worker is classified as a "weekly commuter," and the latter as a "relocator".[1]

A weekly commuter can be expected to have less of an overall impact on a local area than a relocator, since a weekly commuter will continue to spend some of his or her time away at home. Nevertheless, the demand for housing, food, medical services, etc. will be greatly affected by the number of weekly commuters in an area. Consequently, in order to assess the full population impact, it is necessary to consider the aggregate number of relocators and weekly commuters projected for each area.

Table 1 presents the average projected population impact for each year in each Kentucky synfuel region county, 1982-1990. Table 2 presents the average projected percentage impact in each

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1. "Weekly Commuters" are workers who reside in the impact area during the work week but return to their permanent residences (which are outside of the daily commuting region) on the weekends. "Relocators" are workers and dependents who migrate into the impact area and establish permanent (i.e. full-time) residences there.

county, relative to the baseline population projection.[2] The figures in both tables are based on the assumption that all plants will be built as currently scheduled.

The projected impact is not spread evenly throughout the Kentucky portion of the synfuel region. The site counties, Breckinridge, Daviess and Henderson Counties, are expected to receive the vast majority of weekly commuters and relocators, while other counties such as Grayson and Hopkins are expected to receive relatively few. Furthermore, the distribution of impact shifts across counties during the projection period. Daviess County, for example, is expected to experience the greatest average numeric impact of all the counties in 1982, 1983 and 1984, while in 1985 and 1986 Henderson County is projected to do so.

When considering percentage impact relative to baseline population projections, different patterns appear. While Daviess and Henderson Counties are consistently projected to experience the greatest numeric impact, other counties, such as Breckinridge and Hancock, are frequently projected to experience the greatest percentage impact. Thus, these latter, more rural counties, will have greater difficulty in absorbing or accomodating their synfuel-related population influx, even though Henderson and Daviess counties are expected to receive considerably greater numbers of weekly commuters and relocators.

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[2] Baseline projections indicate what the future population in an area will be if past (or current) fertility, mortality and net-migration patterns are maintained into the future. Such projections do not directly reflect the impact of future major construction projects or economic development programs and policies. Such projections therefore constitute a 'baseline' which can be used to assess actual and potential demographic impacts resulting from major projects such as synfuel plant construction.

Since 1977 the official baseline population projections for Kentucky, its regions and counties, have been produced by the staff of the Population Research Unit at the University of Louisville's Urban Studies Center. These projections were last updated in 1981, using the 1980 Census data which was available at that time. They will be updated again in the Summer of 1982 after more detailed census data are released.

The maximum quarterly projected impact for each county is presented in Table 3. In some cases the maximum quarterly impact is substantially greater than the maximum annual projected impact. This is due to the fact that in most counties, the number of weekly commuters and relocators declines rapidly once the 'peak' impact is experienced. A further pattern worth noting concerns the timing of maximum impact. Fringe counties such as Grayson, Hopkins and Muhlenberg tend to experience their greatest impacts much earlier in the projection period than do the central counties of the impact region such as Breckinridge, Daviess and Henderson.

While it is important to assess the maximum impact a county should expect, it is also useful to consider what the average impact is expected to be over the entire period. Given limited resources, it may be more efficient to orient planning and mitigation efforts towards accommodating the average, overall impact in a given county rather than the maximum level of impact, which will exist for only a very brief period of time.

Table 4 presents the median and mean projected quarterly population impact in each of the synfuel region counties.[3] As could be expected, there is great variation across counties, with Henderson, Daviess and Breckinridge Counties being projected to experience the greatest average impacts.

Referring back to my discussion of generic issues regarding the financing of public infrastructure, it is worth noting that three projects in two counties will create not only the tax lead time problem but also serious problems of jurisdictional mismatch. That is, property taxes from the projects would accrue to the counties while the population influx is expected to fall on the cities in those counties, as well as surrounding areas. In addition, the state has estimated that total state and local property tax revenue from the projects would accrue 90% to the state and 10% to the counties. Revenues do not become at all significant until the projects are nearly completed.

In attempting to plan for impacts, then, our communities are faced with a considerable risk as project revenues do not materialize early enough and project schedules have, and probably will continue to, slip as evidenced in the most current construction schedule (see Figure XIII).

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3. The "median" impact for a given county represents the level of impact which is exceeded during 17 of the 34 quarters in the projection period. The "mean" impact is simply the arithmetic average impact of all 34 quarters. In those cases where the distribution of impact over time is not 'normal' (i.e. bell-shaped), the median is often considered to be a more valid measure of "average" impact than the mean.

CONCLUSION

There is no consensus regarding the appropriate role of the federal government in socio-economic impact mitigation. Consequently, there is no federal policy on mitigation of socio-economic impacts from synthetic fuels development. This situation is ironic, for the U.S. Synthetic Fuels Corporation is a key actor in the development of a synthetic fuels industry, an industry which will generate substantial impacts on states and local communities

The absence of federal policy means that there are no guidelines for the two dozen or so existing federal programs which could be of assistance to states and local communities in the mitigation of socio-economic impacts. Such guidelines could redirect existing programs (e.g., water and sewer construction grants, rural housing loans) to give greater emphasis to areas impacted by energy developments.

The only program which was specifically designed to address the problem of socio-economic impacts is Section 601 of the Powerplant and Industrial Fuel Use Act. Although there are limitations in the coverage of 601 (e.g., coal liquefaction project impacts are not covered), it is the only program which recognizes a federal responsibility for impact mitigation. However, the availability of funds has been a major impediment to the effective administration of this program.

Given the predominant mood of the Reagan administration and the current fiscal crisis, the prospects are slim for federal involvement in impact mitigation efforts. However, the role of the SFC in the development of a synthetic fuels industry could be "leveraged" to ensure that project sponsors develop and implement comprehensive, effective socio-economic mitigation plans. This minimum strategy would require well-defined and effective communications channels between the SFC, project sponsors, state and local governments, and other public representatives. It would also require a willingness on the part of the SFC to accord socio-economic impact mitigation plans the same status in the decision-making process as financing, construction and other plans.

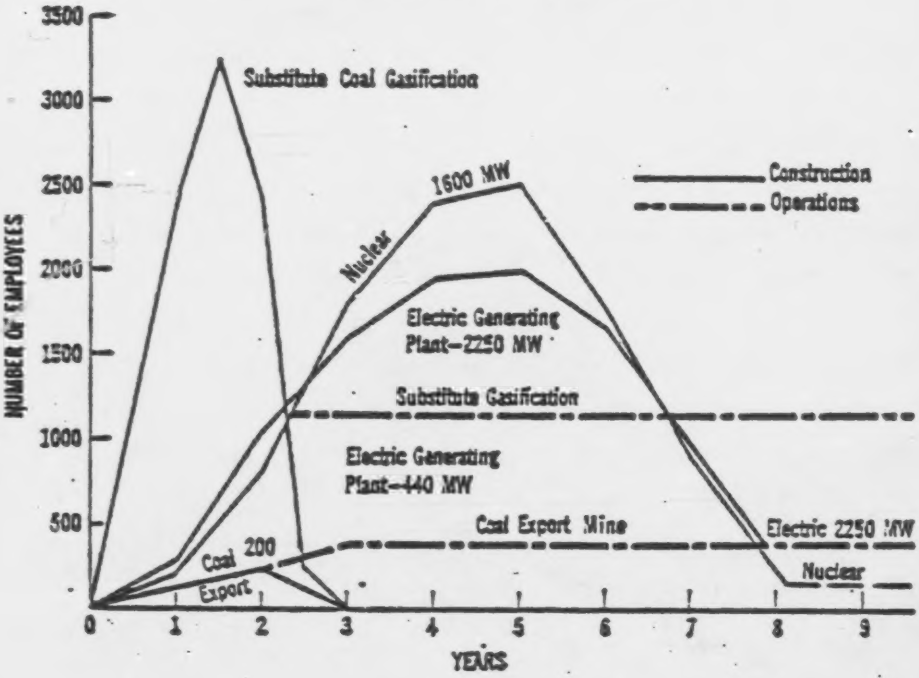
Tax incentives should be provided to encourage developers of synthetic fuels projects to provide various forms of mitigation assistance to communities impacted by project construction and operation. Serious consideration should be given to amending the Internal Revenue Code to improve tax treatment of a company's expenses for qualified impact assistance expenditure. Companies should be allowed to take Federal tax deductions for prepayment of state or local taxes in the year made. In addition, impact assistance provided by project developers should be allowed to consider impact assistance expenses as normal business expenses and to deduct those expenses in computing their federal tax liabilities.

Mr. Chairman, that concludes my formal statement. I am happy to answer any questions you or the Committee may have.

APPENDIX

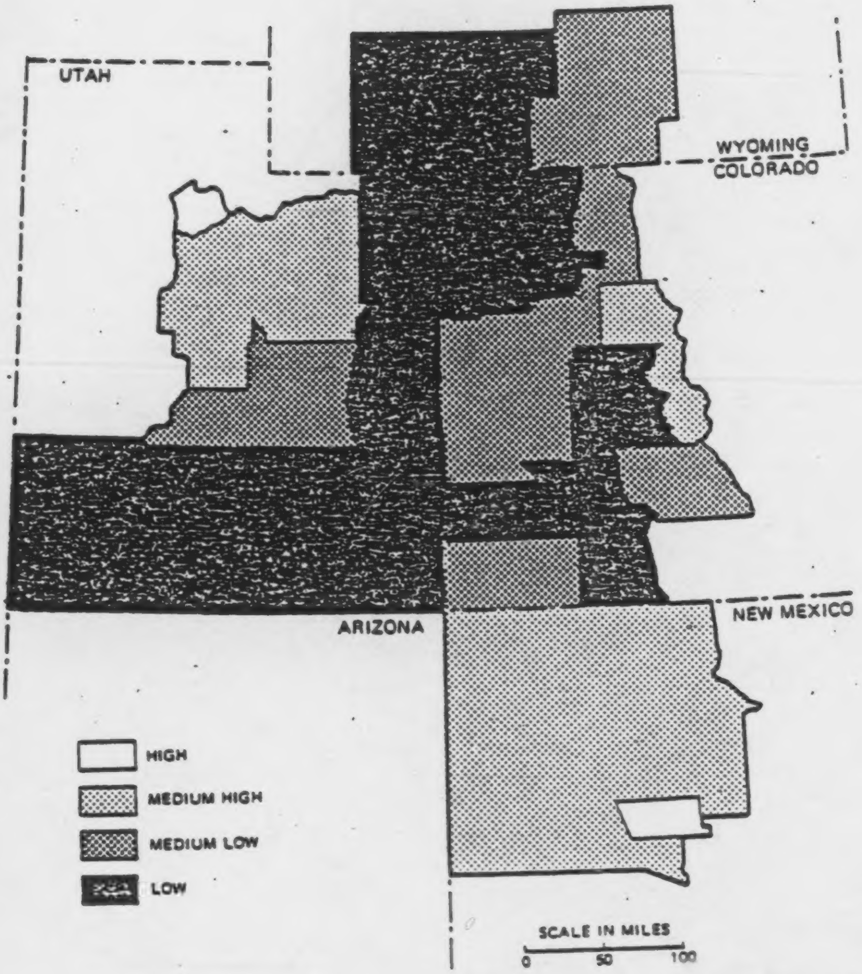
FIGURE I

EMPLOYMENT PATTERNS FOR SELECTED ENERGY PROJECTS



Source: *Rapid Growth From Energy Projects*, HUD, 1976.

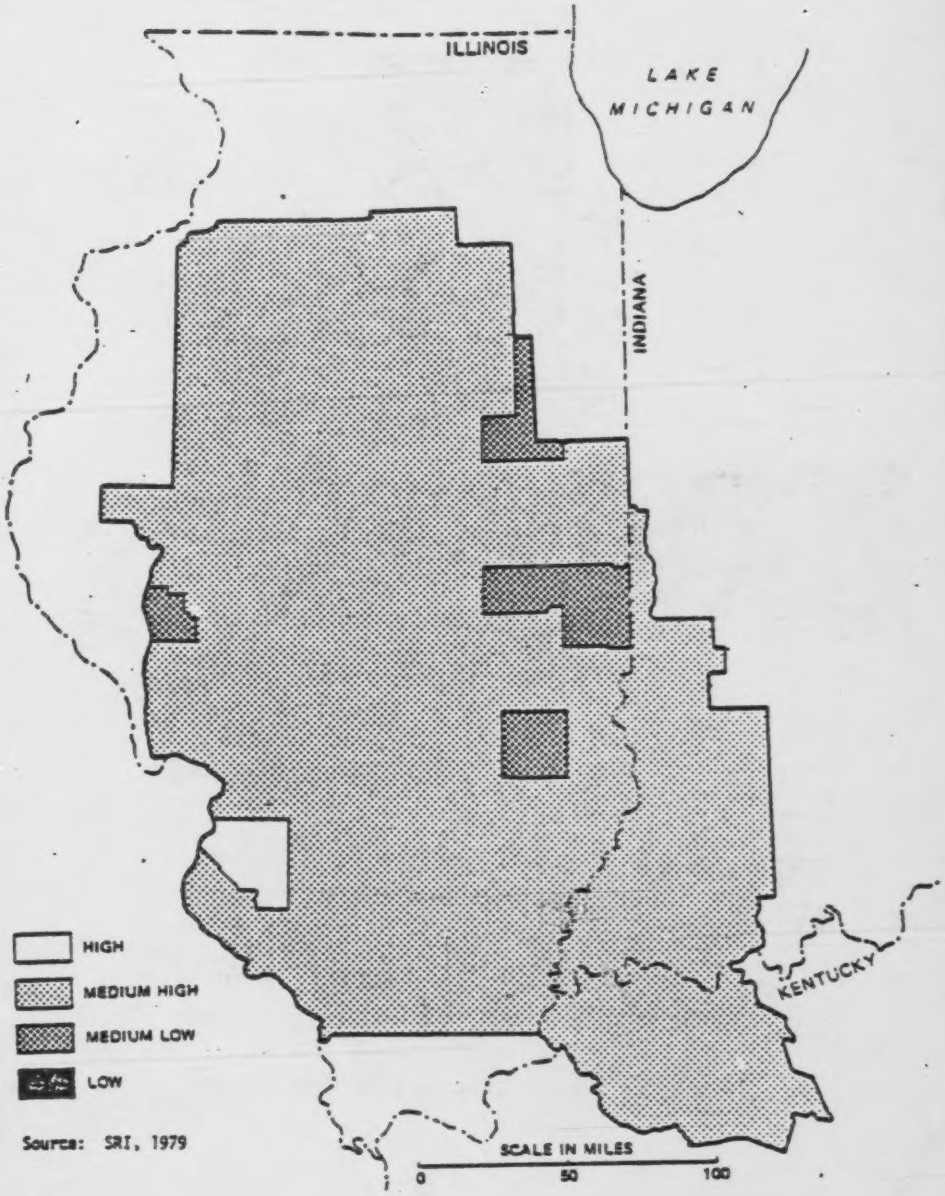
FIGURE II


UTAH
WYOMING
COLORADO
NEW MEXICO
ARIZONA
HIGH
MEDIUM HIGH
MEDIUM LOW
LOW
SCALE IN MILES
0
50
100

Source: SRI, 1979

Relative Ease of Siting Based on Socioeconomic Capacity

FIGURE III


ILLINOIS
LAKE MICHIGAN
INDIANA
KENTUCKY
HIGH
MEDIUM HIGH
MEDIUM LOW
LOW
SCALE IN MILES
0
50
100

Source: SRI, 1979

Relative Ease of Siting Based on Socioeconomic Capacity

FIGURE IV

COAL CONVERSION FACILITIES PLANNED FOR THE WESTERN KENTUCKY REGION

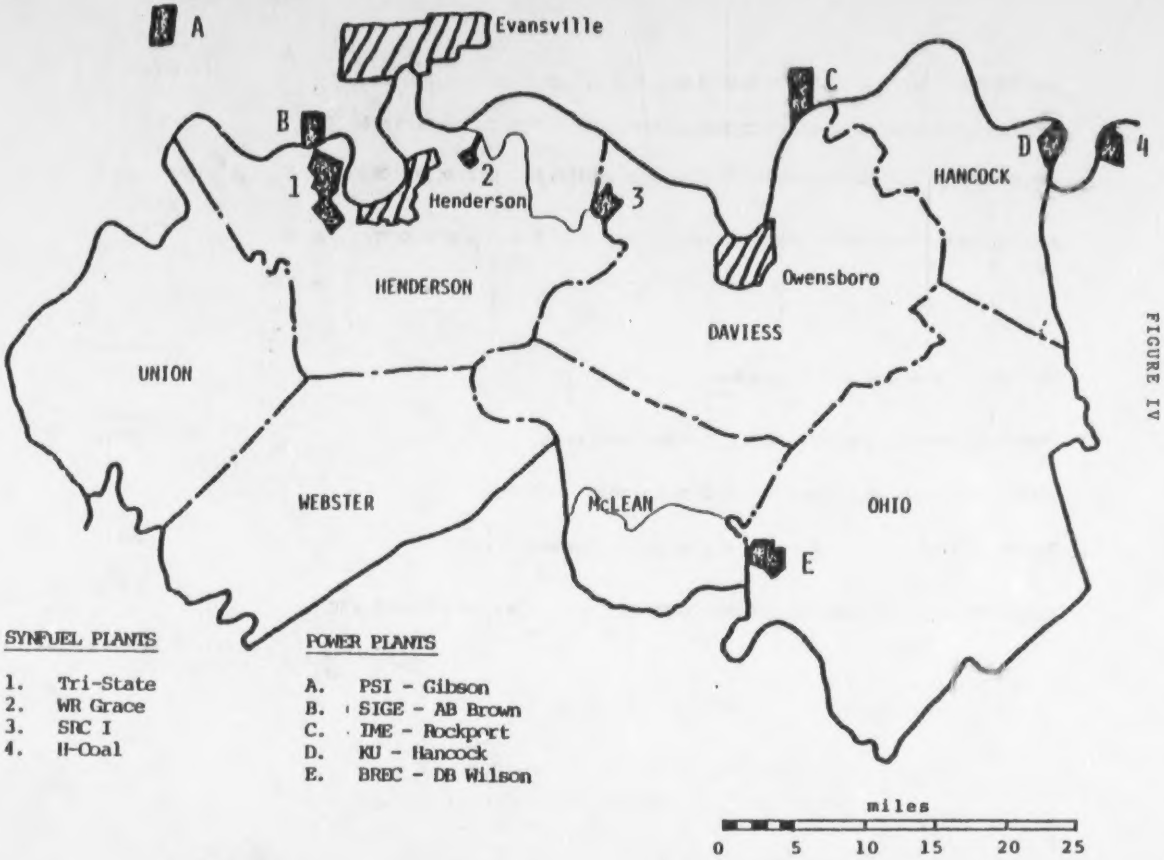

A
Evansville
B
C
D
4
1
2
Henderson
3
HANCOCK
Owensboro
HENDERSON
DAVIESS
UNION
WEBSTER
McLEAN
OHIO
E
SYNFUEL PLANTS
1. Tri-State
2. WR Grace
3. SRC I
4. H-Coal
POWER PLANTS
A. PSI - Gibson
B. SIGE - AB Brown
C. IME - Rockport
D. KU - Hancock
E. BREC - DB Wilson
miles
0
5
10
15
20
25

FIGURE V

COMPARATIVE PROJECT SCHEDULES:
Synfuels and Conventional Power Plants

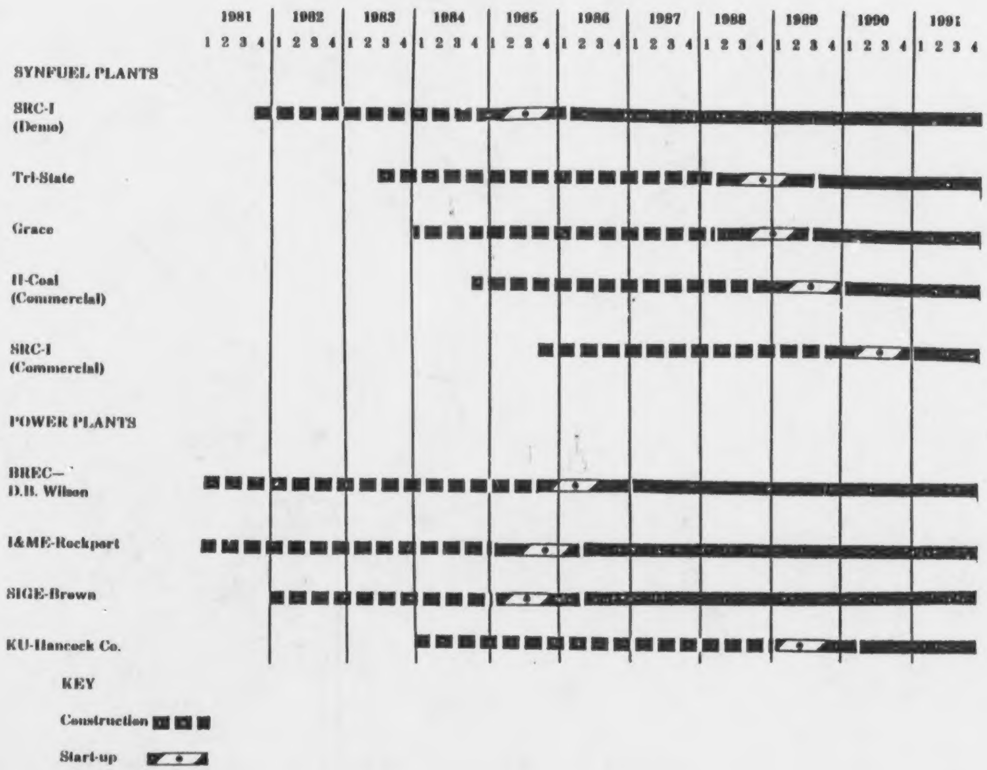
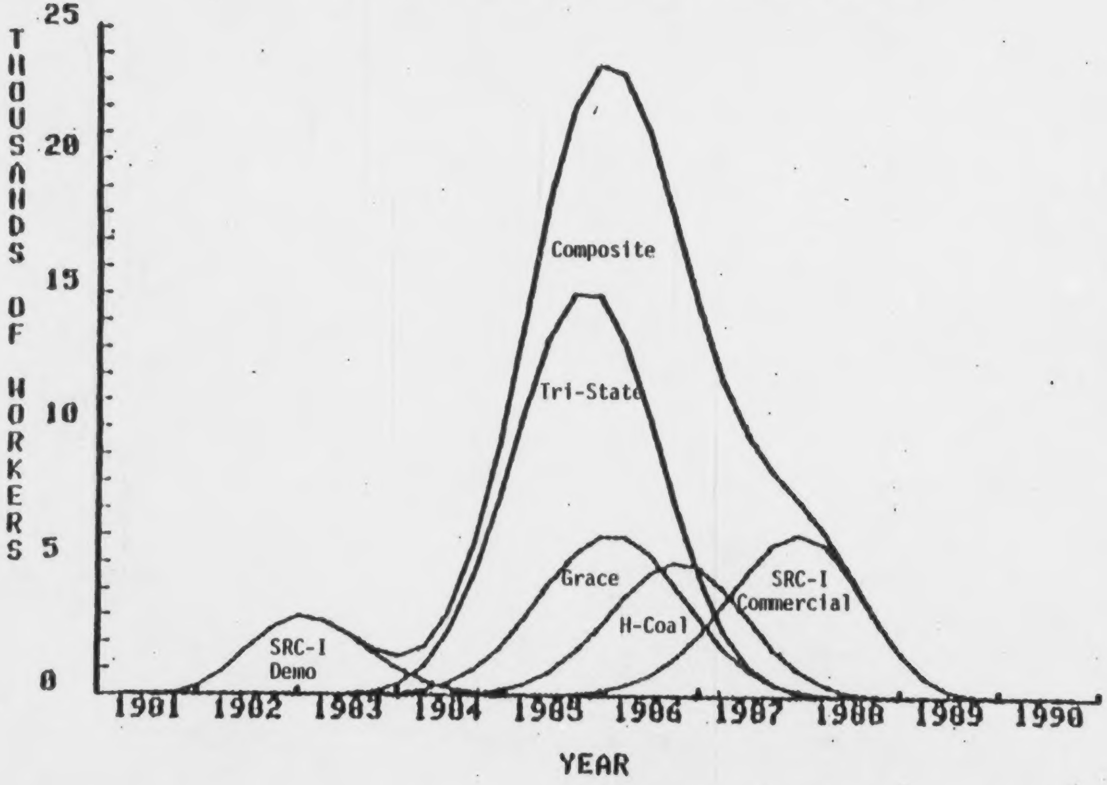


FIGURE VI

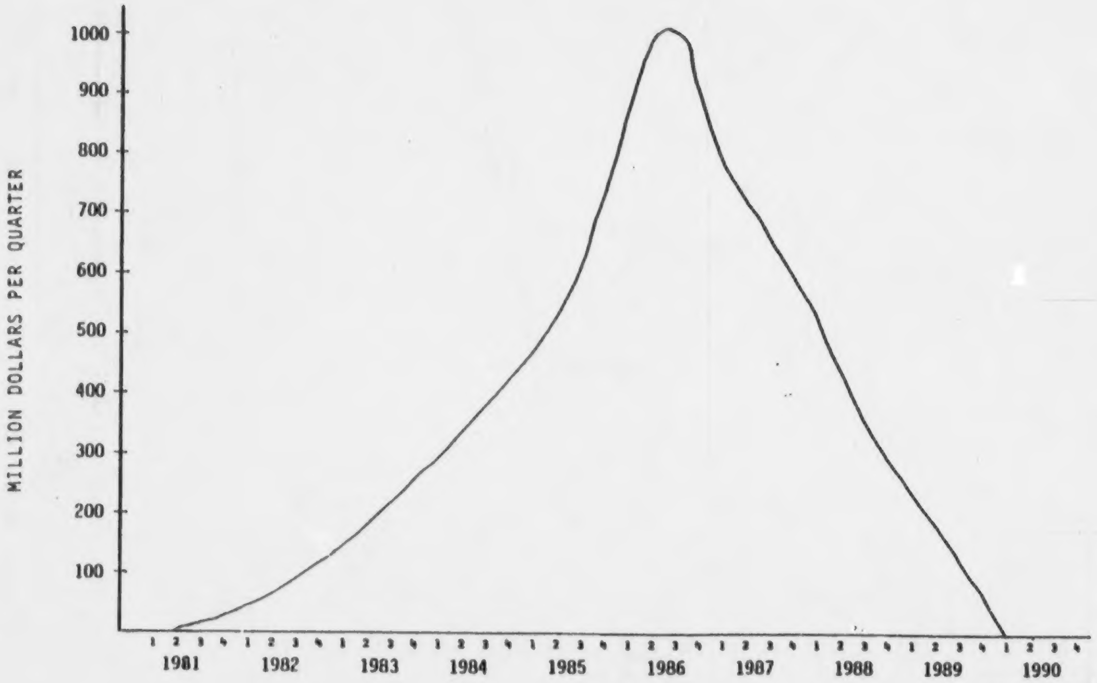
TOTAL LABOR REQUIREMENTS-ALL PROJECTS



KDOE 9/18/80 ADJUSTED CURVES

FIGURE VII

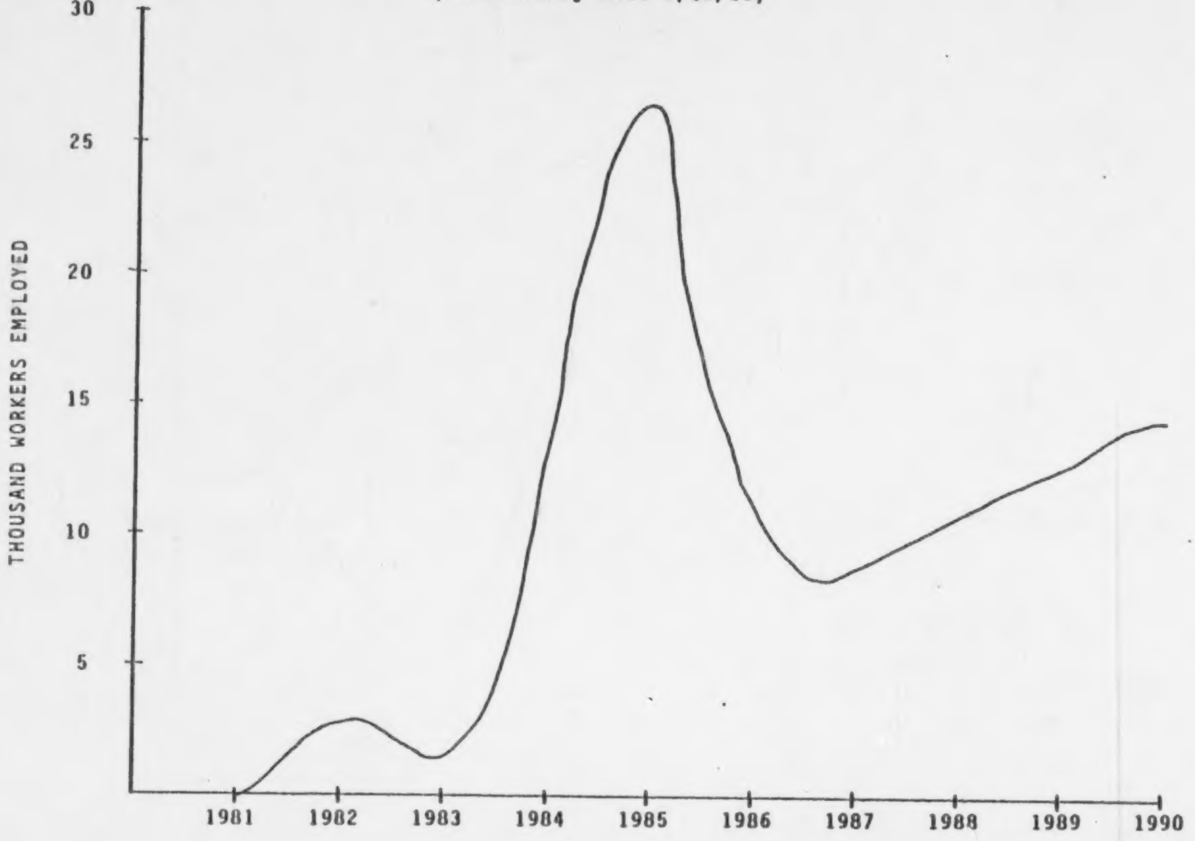
CAPITAL CONSTRUCTION
Per Quarter
(Preliminary Data)



Source: KDoE

FIGURE VIII

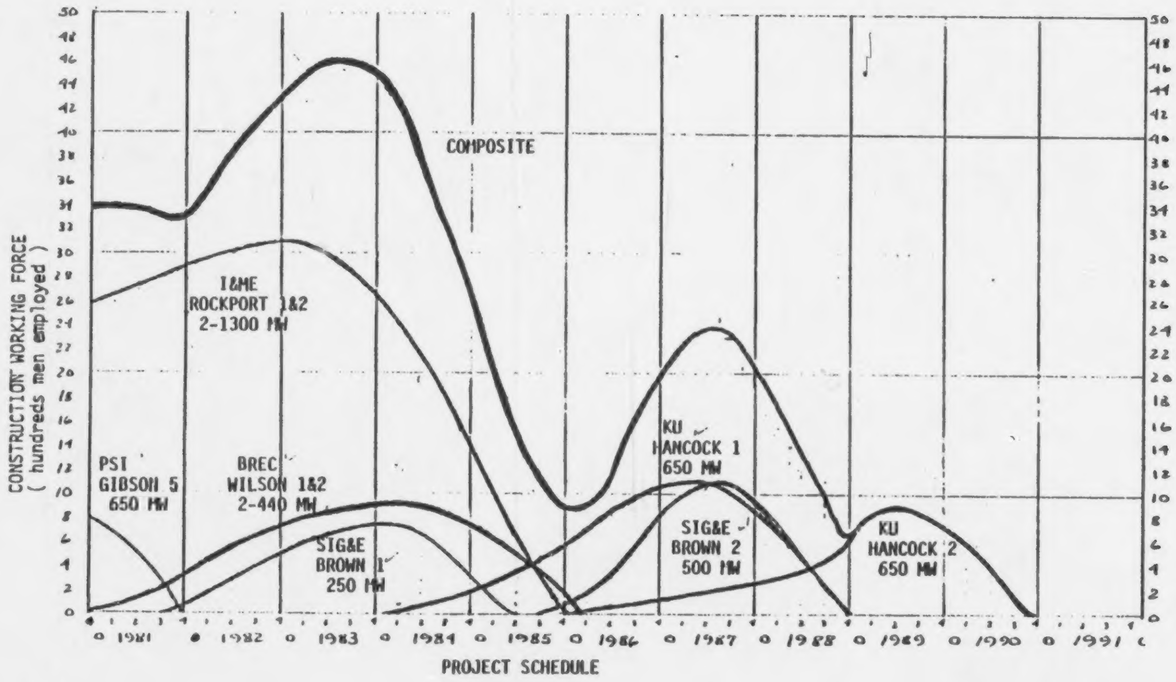
CONSTRUCTION, OPERATING, AND MINING
EMPLOYMENT BY QUARTER
(Preliminary Data 9/18/80)



Source: KDoE

FIGURE IX

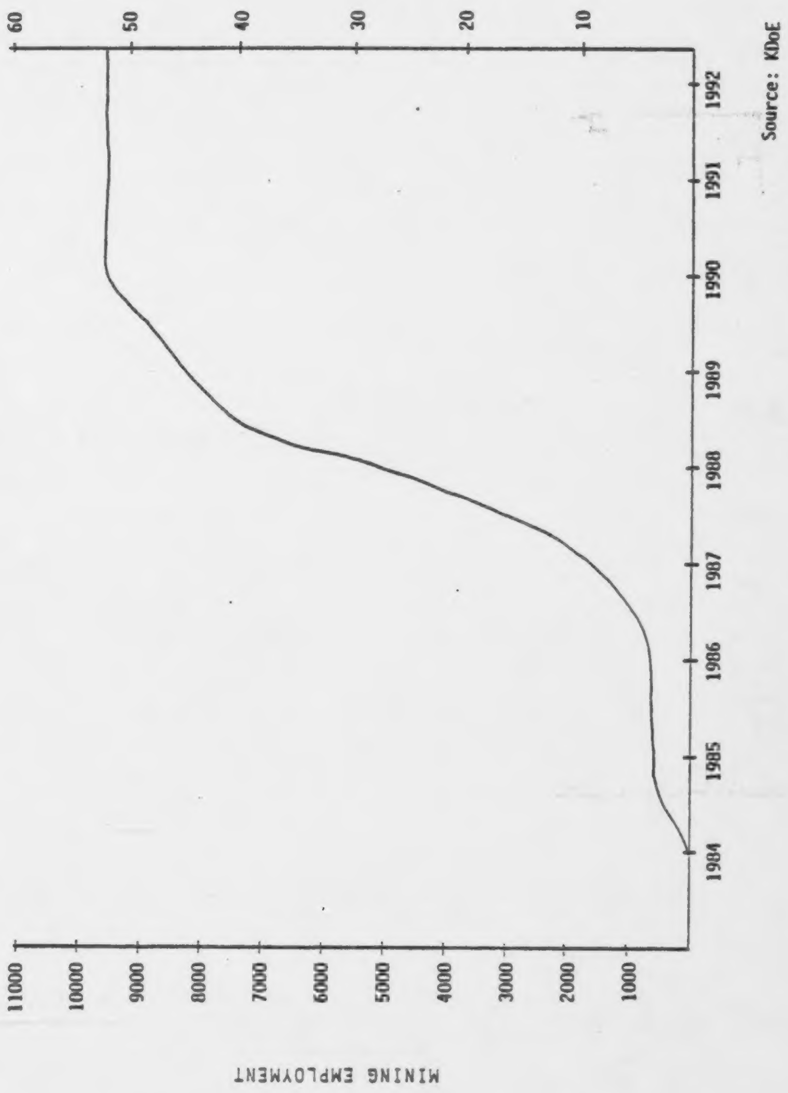
PRELIMINARY DATA
Subject to extensive revision



KDOE
TECHNICAL ASSESSMENT
8/8/80

FIGURE X
MINING PAYROLL PER QUARTER
(Million Dollars)

MINING EMPLOYMENT AND PAYROLL
(Preliminary Data)



Source: KDoE

CONSTRUCTION, OPERATING, AND MINING
WAGES BY QUARTER, INCOME TAX BY QUARTER
(Preliminary Data 9/18/80)

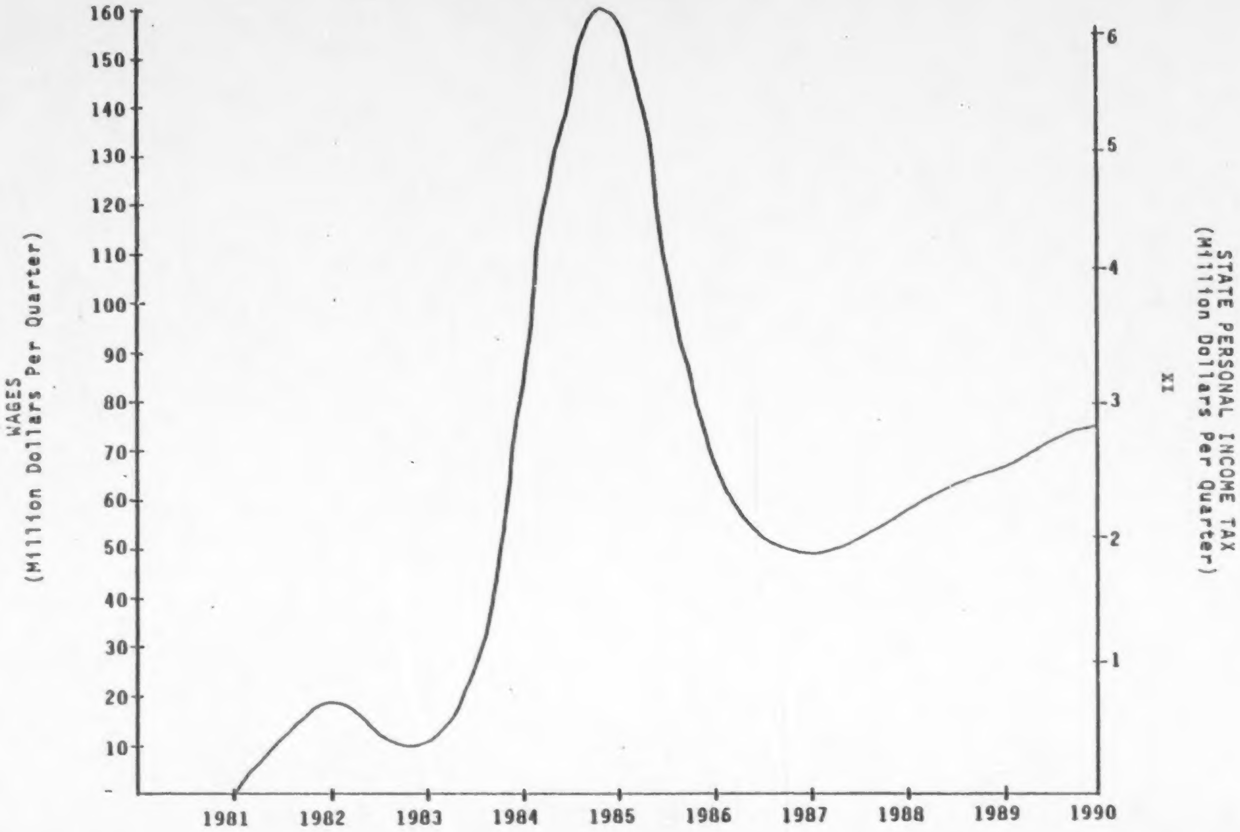
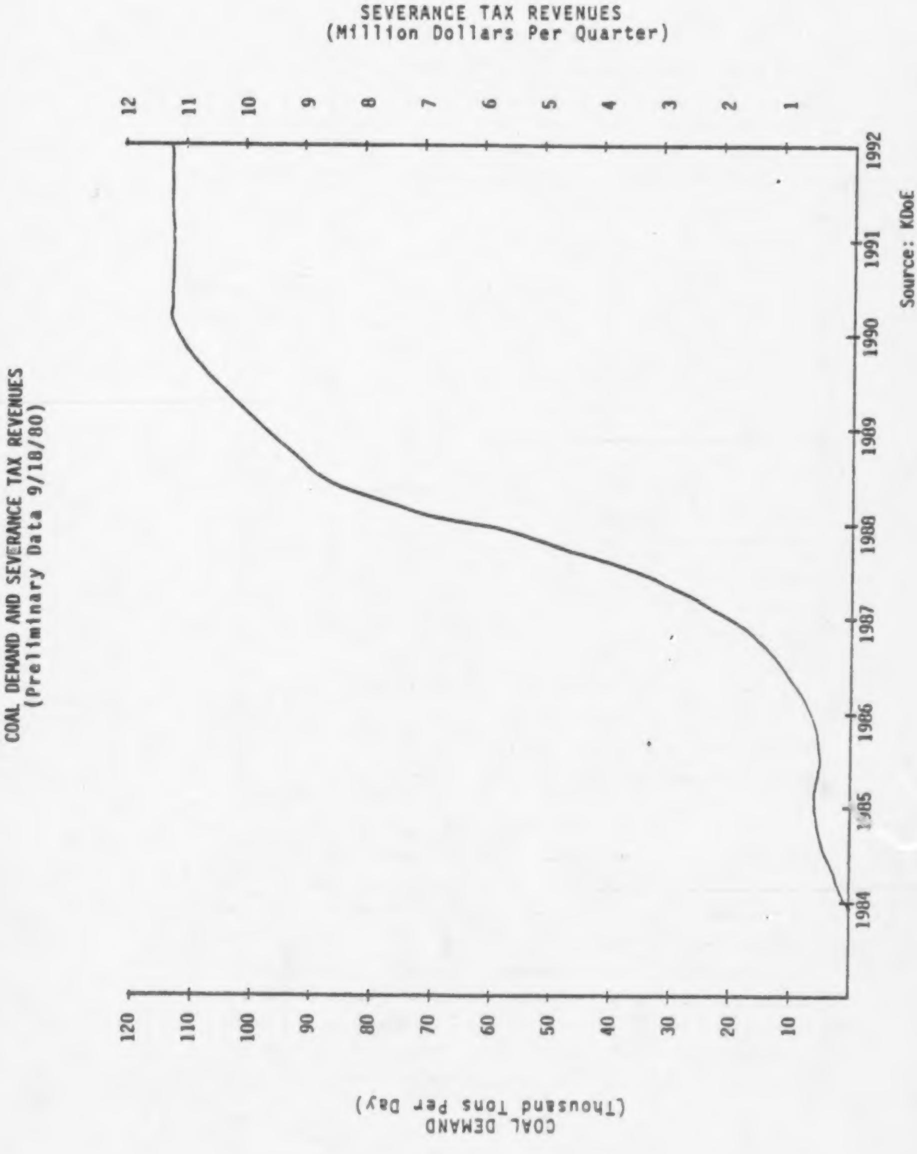


FIGURE XII

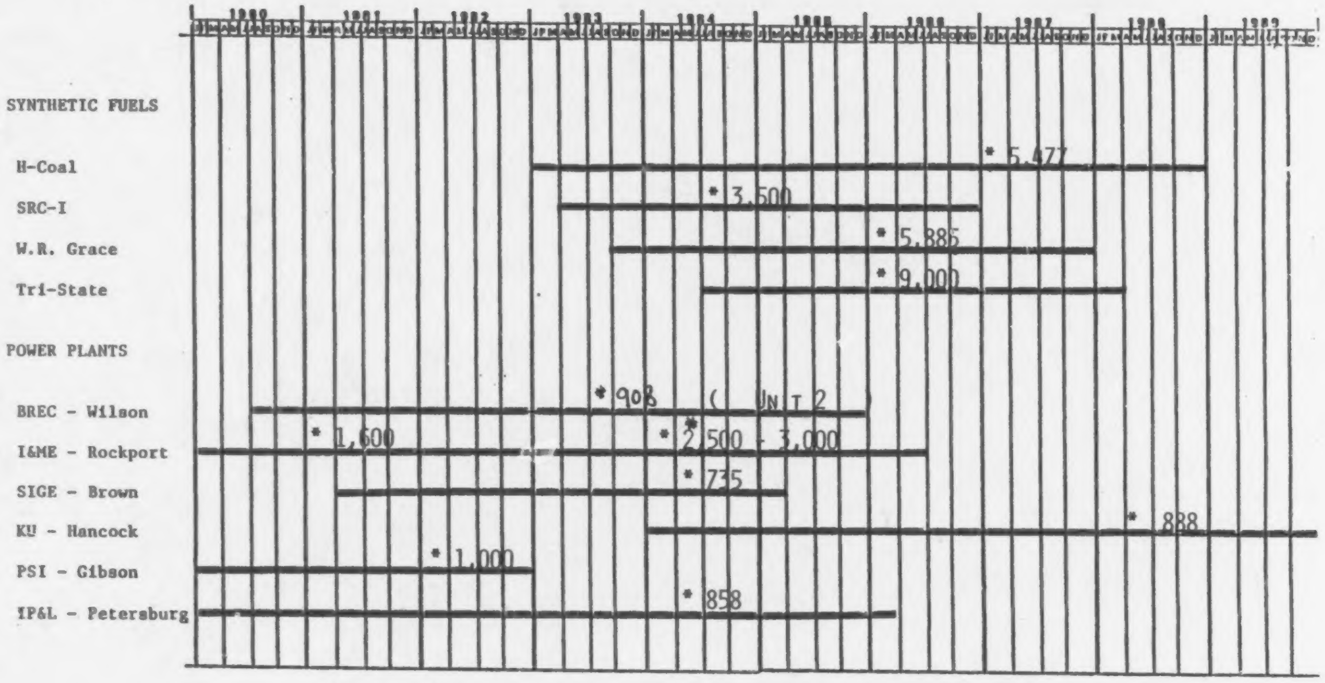


COAL DEMAND AND SEVERANCE TAX REVENUES
(Preliminary Data 9/18/80)

Source: KDoE

FIGURE XIII

2/16/82



WESTERN KENTUCKY ENERGY PROJECT CONSTRUCTION SCHEDULE

*Peak manpower estimates

TABLE 1: Annual Average Projected Population Impact
in Kentucky Synfuel Region Counties, 1982-1990

	Average Projected Weekly Commuters and Relocators*								
County	1982	1983	1984	1985	1986	1987	1988	1989	1990
Breckinridge	0	195	939	2,953	4,745	4,122	1,096	390	395
Daviess	640	2,588	4,076	6,965	9,760	8,631	3,152	1,197	1,144
Grayson	29	65	54	18	0	0	0	0	0
Hancock	90	418	672	884	1,434	1,803	760	194	177
Hardin	0	18	100	315	501	424	100	39	41
Henderson	187	1,680	3,316	8,051	11,395	8,557	2,841	1,287	1,239
Hopkins	59	134	105	42	0	0	0	0	0
McLean	93	401	554	587	694	739	359	116	113
Meade	0	39	196	633	1,010	851	200	80	83
Muhlenberg	88	198	157	64	5	6	6	6	6
Ohio	120	471	489	176	225	672	375	91	83
Union	3	200	490	1,754	2,568	1,789	508	271	268
Webster	3	200	442	1,138	1,625	1,257	428	188	183
Impact Region (KY Portion)	1,312	6,607	11,590	23,580	33,962	28,851	9,825	3,859	3,732

*Unweighted Average of Quarterly Projections.

SOURCE: Projecting Demographic Impacts of Synfuel/Power Plant Construction in Western Kentucky: 1982-1990. February, 1982.

TABLE 2: Annual Average Projected Percentage Population Impact in Kentucky Synfuel Region Counties, 1982-1990

County	Average Projected Percentage Impact*								
	1982	1983	1984	1985	1986	1987	1988	1989	1990
Breckinridge	0.0	1.1	5.4	16.8	26.8	23.1	6.1	2.1	2.2
Daviess	0.7	2.9	4.6	7.8	10.8	9.5	3.4	1.3	1.2
Grayson	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0
Hancock	1.1	5.3	8.5	11.0	17.8	22.2	9.3	2.4	2.1
Hardin	0.0	0.0	0.1	0.3	0.5	0.4	0.1	0.0	0.0
Henderson	0.4	4.0	7.8	18.6	26.1	19.4	6.4	2.9	2.7
Hopkins	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0
McLean	0.9	3.8	5.1	5.3	6.2	6.5	3.1	1.0	1.0
Meade	0.0	0.2	0.8	2.6	4.0	3.3	0.8	0.3	0.3
Muhlenberg	0.3	0.6	0.5	0.2	0.0	0.0	0.0	0.0	0.0
Ohio	0.5	2.1	2.1	0.8	0.9	2.8	1.5	0.4	0.3
Union	0.0	1.1	2.6	9.4	13.6	9.4	2.6	1.4	1.4
Webster	0.0	1.3	2.8	7.3	10.2	7.8	2.6	1.1	1.1
Impact Region (KY Portion)	0.3	1.5	2.6	5.2	7.4	6.2	2.1	0.8	0.8

*Unweighted Average of Quarterly Projections.

SOURCE: Projecting Demographic Impacts of Synfuel/Power Plant Construction in Western Kentucky: 1982-1990. February, 1982.

TABLE 3: Maximum Projected Quarterly Population Impact in Kentucky Synfuel Region Counties, 1982-1990

County	Quarter	Relocators and Weekly Commuters Maximum Impact Numeric	Percent
Breckinridge	1987 (1)	5,120	28.8
Daviess	1987 (1)	11,093	12.2
Grayson	1983 (2)	70	0.3
Hancock	1987 (2)	1,958	24.2
Hardin	1987 (1)	537	0.5
Henderson	1986 (4)	12,235	27.9
Hopkins	1983 (2)	144	0.3
McLean	1987 (1)	831	7.4
Meade	1987 (1)	1,077	4.2
Muhlenberg	1983 (2)	215	0.6
Ohio	1987 (3)	720	3.0
Union	1986 (4)	2,737	14.5
Webster	1986 (4)	1,760	11.1
Impact Region (KY Portion)	87 (1)	37,812	8.2

SOURCE: Projecting Demographic Impacts of Synfuel/Power Plant Construction in Western Kentucky: 1982-1990. February, 1982.

TABLE 4: The Median and Mean Projected Quarterly Population Impact in Kentucky Synfuel Region Counties, 1982-1990

Counties	Median Impact		Mean Impact	
	Numeric	Percent	Numeric	Percent
Breckinridge	688	3.8	1,722	9.7
Daviess	3,675	4.1	4,421	4.9
Grayson	0	0.0	20	0.1
Hancock	654	8.2	746	9.3
Hardin	66	0.1	179	0.2
Henderson	2,898	6.8	4,463	10.2
Hopkins	0	0.0	40	0.1
McLean	502	4.5	423	3.8
Meade	132	0.5	359	1.4
Muhlenberg	6	0.0	63	0.2
Ohio	272	1.2	313	1.3
Union	428	2.3	908	4.8
Webster	384	2.4	632	4.0
Impact Region (KY Portion)	10,282	2.3	14,288	3.1

SOURCE: Projecting Demographic Impacts of Synfuel/Power Plant Construction in Western Kentucky: 1982-1990. February, 1982.

Mr. FUQUA. Mr. Gottlieb?

[The biographical sketch of Mr. Gottlieb follows:]

STEVEN GOTTLIEB

Previous Positions:

1979-82: Deputy Assistant General Counsel for Environment, Department of Energy.

1976-78: Attorney, Wald, Harkrader and Ross, Washington, D.C.

1974-76: Assistant General Counsel, Office of Management and Budget.

Education:

Columbia College, B.A. 1968.

Columbia Law School, J.D. 1972.

Mr. GOTTLIEB. Mr. Chairman and members of the committee, I am Steven Gottlieb, Director of Environment for the Office of Projects in the U.S. Synthetic Fuels Corporation. In that capacity I am responsible for environment and socioeconomic matters relating to projects before the Corporation. I am here today to discuss how the Corporation considers socioeconomic factors in its activities.

Let me first say that Chairman Noble and President Schroeder have asked me to assure you that the Corporation will give meaningful consideration to socioeconomic factors in the Corporation's decisionmaking processes.

The Energy Security Act requires that the Corporation foster the creation of synthetic fuels facilities in an environmentally acceptable manner. We believe that mitigation of socioeconomic impacts is a central element of environmental acceptability. We also believe that mitigation of socioeconomic impacts is directly relevant to prudent project management and the completion of projects on schedule and within cost.

EVALUATION CRITERIA

Our treatment of socioeconomic impacts in the decisionmaking process is reflected in our evaluation criteria. The supplement to the initial solicitation, approved by the Corporation's Board of Directors on December 11, 1981, states generally that in determining project strength: "The Corporation will attempt to select those projects that minimize in a cost-effective manner environmental, health and safety, socioeconomic and water impacts." More specifically, in the socioeconomic area:

> The Corporation will consider the extent to which the proposer:
>
> 1. Realistically identifies project needs during both the construction and operating phases of the project vis-a-vis the existing community and regional infrastructure, housing and services;
> 2. Shows that the identification of problems and the impact mitigation strategy (where required) have been developed in close collaboration with affected States and local communities, and with input from affected citizenry; and
> 3. Provides evidence that acceptable financial arrangements to carry out impact mitigation strategies will be in place or available when needed.
>
> The Corporation will look for assurance that the essential housing and infrastructure will be in place in time to accommodate the needs of the project work force, including temporary needs during the peak construction period. Additionally, the degree to which impact mitigation strategy considers areawide impacts from the project and concurrent development will be assessed.

THE EVALUATION PROCESS

Let me explain how the Corporation actually evaluates projects under these socioeconomic criteria. The level of socioeconomic impacts and the adequacy of the plan to mitigate those impacts are evaluated based on a variety of inputs.

First, the Corporation's staff reviews the project sponsor's proposal, which includes all supplementary information.

Second, the Corporation draws extensively upon State and local government expertise. Specifically, we solicit continuous input from State and local government officials through informal discussions. If projects reach our detailed analysis phase, we then make a formal request to the governor for comments on the project. Also, we track and review both siting permits (and similar approvals) and any nonpermit mitigation agreements which have been negotiated between the sponsor and State and local officials; from this we can determine the scope of the sponsor's mitigation activities which are required by State and local governments through permit or agreement.

Third, we receive and review comments from individuals and citizen groups on all matters, including socioeconomic. As part of this, we are holding a public meeting in the area of potential impact for each of the five projects now being actively considered for assistance. Based on these inputs, the Corporation assesses the extent of potential community impact and the adequacy of the proposed mitigation measures, including the availability of financing for implementing such measures. Let me add that the Corporation has expertise to independently evaluate these inputs to assess their validity, so we are not obliged to accept claims at face value. I will discuss staff support in the socioeconomic area at the end of my remarks.

As members of the evaluation team, the environment staff provides input into each project evaluation. This input is consolidated with other relevant evaluation material to provide an integrated report to the Board of Directors. Under the evaluation criteria, a project sponsor will be recommended highly where it has, in our opinion: (1) thoroughly evaluated the potential impacts of the facility; (2) actively worked with State and local officials to develop a mitigation plan, where such plan is needed; and (3) established a sound financial mechanism for timely implementation of the mitigation plan. Socioeconomic factors are one of six criteria used by the Board in evaluating project strength.

SOCIOECONOMIC REVIEW—STATUS AND OUTLOOK

Project evaluation, which includes socioeconomic considerations, is an ongoing process at the Corporation. Under the initial solicitation, some of the activities I have described were included in the evaluation process to date, which began with 63 projects.

During the course of the evaluation, a number of projects withdrew and others were not advanced due to ineligibility, lack of maturity, or lack of strength, as defined by our selection criteria. In late March, the Board selected five projects to advance into the verification and negotiation stage. During the next 2 months we will verify information received earlier, obtain updated information, and perform additional analysis of the five projects, including, as appropriate, analysis in the socioeconomic area.

At the conclusion of the further detailed analysis stage, the Corporation then will initiate negotiations with any or all of the five projects leading to possible awards. During the negotiation period we will keep abreast of socioeconomic developments relating to the projects in the financial assistance agreements which are negotiated.

We anticipate that the sponsor will be required, at a minimum, to adhere to its socioeconomic mitigation and monitoring commitments as established by State and local permits or agreements between State and local authorities and the project sponsor. If necessary to insure adequate monitoring and project stability, the Corporation has the option of requiring additional terms and conditions in the socioeconomic area.

This entire process will be repeated for projects applying under our second and subsequent solicitations.

In addition to project specific analysis, the Corporation also considers the broader issues of cumulative, long-term impacts. We are presently preparing an indepth analysis of potential long-term constraints on synthetic fuels development, including socioeconomic impacts, which will contribute to the Corporation's understanding of industry diversity as it applies to our overall program strategy.

STAFFING

Let me briefly describe the staff which performs the analysis and other activities already discussed. We are maintaining a lean, professional staff to perform a review and analysis role. Within the Corporation's Office of Environment we have a staff member with 10 years experience in assessing socioeconomic impacts and developing and evaluating mitigation plans; he will also have additional staff support.

In the Corporation's External Relations Office, two individuals with experience in the socioeconomic field spend a major portion of their time on socioeconomic impacts and mitigation through their discussions with State and local officials and citizen groups. They also track and review siting permits and similar approvals.

The Corporation's Office of Planning has recently installed an environmental-socioeconomic core area headed by a Ph. D. at the Assistant Director level to consider broad trends and impacts as they relate to our long-term strategic plans and programs. The Corporation also has a manpower specialist to review work force estimates, a key factor in determining impacts. If necessary, we will also obtain additional support from outside the Corporation to assure that the tasks which I have described are accomplished in a thorough manner.

CONCLUSION

In conclusion, the Corporation will continue to carefully evaluate socioeconomic impacts and mitigation plans pursuant to its evaluation criteria. This evaluation will assist the Corporation in fulfilling its mandate on two counts: First, it will be operating as a prudent lender, fully aware of major aspects of the project which can affect schedules and costs; second, it will be fostering the creation of synthetic fuels facilities in an environmentally acceptable manner.

Thank you, Mr. Chairman. I would be pleased to answer any questions you may have.

Mr. **Fuqua**. Thank you very much.

We are very pleased to welcome you back, Dr. Carpenter. We appreciate very much your work on the synthetic fuels panel we had several years ago, which I think was a very fine document, and we thank you for your contribution and we are very pleased to welcome you again.

[The biographical sketch of Dr. Carpenter follows:]

SUSAN CARPENTER

Susan Carpenter, associate Director of ROMCOE, Center for Environmental Problem Solving, has designed and directed conflict management programs at community, regional and national levels on resource development, agricultural lands, air quality and energy conservation. She holds a doctorate in future studies and international education from the University of Massachusetts. She has served on numerous national and regional advisory groups for government agencies and other organizations including the U.S. House of Representatives Committee on Science and Technology's Synthetic Fuels Advisory Panel and the Governor of Colorado's Front Range Growth Visions Task Force.

Dr. **Carpenter**. Thank you, Mr. Chairman, and other members of the committee. It is a pleasure to address you today. The center I work for is a private, nonprofit institution that specializes in environmental conflict management. For the last decade, we have worked with people in small western communities that are facing growth and change as a result of development of the Rocky Mountain region's abundant natural resources.

In the 1970's, this kind of growth and change accelerated dramatically as national demands for western oil shale, coal, petroleum and natural gas increased in response to changes in the national and international energy situation. The resulting energy boom brought large numbers of construction workers, miners, and industrial workers to many rural western towns and counties where the population had been stable or declining for many years. Such growth doubled the population of some communities in a few years, affecting virtually every aspect of community life.

Rapid growth often brings badly needed jobs and dollars to areas that have been suffering from economic decline. But population growth can outrun the community's ability to provide housing, schools, medical services and other essential facilities and services. Rapid growth can also bring an overwhelming sense of frustration and powerlessness to people who live in the community, preventing them from responding effectively to the problems and opportunities that come with growth.

Energy industry leaders have realized that industry benefits when a community manages its growth effectively. If the community is an undesirable place to live, companies will have high employee turnover, excessive absenteeism, and low productivity. This translates into high construction costs, delays in schedules and excessive operating costs.

In 1979 our center initiated the rapid growth communities project designed to help people in rapid growth communities respond effectively to that growth. This project is not another academic socioeconomic study. It is a practical effort based on two commonsense ideas. The first is that people who live in rapid growth communities must solve their own problems. They can get valuable advice and assistance from planning consultants, industry, State and Federal agencies and other sources, but the actual solutions to rapid growth problems must come from the communities themselves.

Our second assumption is that the most useful and practical information for people in small communities that are growing rapidly can be found in the experiences and advice of people in communities that have already been through rapid growth. Their successes, their mistakes, their innovative ways of taking advantage of opportunities and solving problems represent an invaluable resource for other rapid growth communities, whether the growth comes from synthetic fuels development; development of coal, petroleum and natural gas; construction of powerplants or other causes.

The focus of the rapid growth communities project is on community preparation for change. Community preparation involves developing an understanding of the nature and extent of the changes that are likely to take place and developing formal and informal institutions and processes that enable community residents to deal with the change in effective ways.

Community preparation for change, financing, and professional planning are three components of a growth management tripod. Together they provide a stable base for the effective management of community change. But if one leg of the tripod is missing, the other two cannot stand alone.

Although money is always needed when growth begins, experience has shown that money will not solve problems unless it is used wisely and knowledgeably. Also, the best professional planning efforts, even when they are adequately funded, are likely to be ineffective if they do not have broad understanding, support and participation from the people of the community. Therefore, community preparation must proceed at the same pace as financing and professional planning efforts if a community wishes to deal effectively with change.

COMMUNITY PREPARATION

The strongest message about community preparation that we have gotten from rapid growth communities is that people must work together as closely as possible and as early as possible. This is not as simple as it sounds. One reason is that people in our part of the country have a strong tradition of self-reliance and independence—westerners are proud of being able to make it on their own. This tradition also affects institutions.

Town councils and county commissions often are suspicious of each other, and sometimes are actively hostile. In some towns, the business community does not get along very well with local government officials. Ranchers and farmers often feel that local government planning efforts threaten their rights as property owners. But we have found that effective community preparation for growth requires these individuals and groups to acknowledge their dependence on each other and their need to cooperate to solve common problems.

Our workshops in rapid growth communities have a strong focus on getting people to talk with each other about the changes that are coming to their community, to think about how these changes are affecting them, collectively as well as individually, and to work together to advance their common interests in effective ways.

During the first 2 years of the rapid growth communities project, our project team talked with over 300 people in four resource communities: Gillette, Wyo.; Green River, Wyo.; Craig, Colo.; and Carbon and Emergy Counties, Utah. Each of these communities experienced rapid growth in the 1960's and 1970's from various forms of energy or natural resource development—coal mines, powerplants, oil and gas well, or trona mines. We met with local government officials, local business people, human service providers, physical service providers, senior citizens, teenagers, newcomers, oldtimers, and other key people in each of the four communities. They told us what happened to them and their community when rapid growth occurred, and how they responded to it. They told us what responses were successful, which ones did not work so well, what they might do differently and what they would advise others to do in similar situations.

We have organized this information into 22 categories and are publishing reports of the community residents' experiences and advice in each category.

FINDINGS AND RECOMMENDATIONS

Our findings comprise over 3,000 pages of information. I cannot describe all of them here. Nevertheless, I would like to summarize some of our more important and interesting findings.

Effects on local business: Rapid growth had some surprising effects on local businesses in our four resource communities. Local business is the heart of a small community. Business people in small towns sometimes assume that growth will bring prosperity to them almost automatically. But it is not that simple. Local business people in all of our resource communities reported that they could not continue doing business as usual. They either had to expand to meet changing demands for their goods and services, or they had to get out of business. They found it difficult to compete with chain stores and shopping centers that invariably came into the area while maintaining a business at the level it was before.

This pressure to grow or get out of business created great strains on many long-time business people. Many had been very conservative for years—they were reluctant to go into debt. Expansion required borrowing large sums of money, which was undesirable, or even impossible, for many local merchants. Borrowing money also entailed substantial risk. If the growth did not continue, business people feared they would be left with a large debt, but no large profits to pay it off. Many had seen energy booms and busts before. Hence, they had no confidence that this boom was there to stay—and was worth investing in. The end result was that many local business people chose or were forced to go out of business, and chain stores and shopping centers often replaced Main Street as the primary center of retail activity.

The local business people we talked to made several recommendations about ways in which some of their problems might be handled. First, they stressed the great importance of accurate information. Often the business community is not part of the public growth planning process. Local government officials may work with industry to predict growth rates and local impacts on public services; however business people often are not included in this process.

If growth projections and related information are available to local business people as well, they can be very useful to business planning. In Gillette, for instance, industry growth figures are collected, compiled, and distributed by the chamber of commerce. This has proven to be a very effective way of getting both the public and private sector aware of growth issues and impacts, and planning together to deal with the change.

A second recommendation is that local businesses need financing assistance either from local banks or other sources. Financing is often hard to come by, since banks are frequently skeptical about the continuation of the boom as well. Perhaps the Small Business Administration could provide special financing assistance to businesses in rapid growth communities.

A third recommendation is that local business people and local government people must work together to accomplish business and community goals. Public/private cooperation in our resource communities was clearly helpful in maintaining a viable downtown commercial district and a healthy downtown atmosphere.

In Gillette, where the local government worked with the downtown merchants on a special improvement district, the downtown area was kept alive and well, even while shopping centers were established on the outskirts of town. In the other communities we worked with, the local government and the downtown merchants did not cooperate as much, and the results of downtown redevelopment, or even maintaining the status quo, were much less successful.

Effects on local government: Rapid growth had major effects on local government, as town and county governments were called upon to provide traditional services to more people, as well as many new services which they had not been required to provide before. Very often newcomers came from much larger communities, and moved into the rapid growth community expecting all the facilities and services of their old hometown. This created pressures on the local government to expand into service areas that they had not dealt with before, such as medical care, mental health, recreation, and sometimes even housing.

In order to provide all these new and expanded services, local governments needed more money. After the energy facilities are built, much of this money comes from the increased taxes, although property taxes normally go to the county government and school district, not to the town, where most of the people live. This means that cities (and counties early in the growth period) must seek outside sources of funds—grants, or bonds, which they had not needed before.

Local governments frequently found themselves in a double bind. If the community issued bonds to pay for capital improvements that growth projections indicated were needed, and the tax money did not come through, the community would be caught with no funds to pay their bonds in a virtual state of bankruptcy. On the other hand, if the community waited until the need was tangible, the effect was devastating. The magnitude of the problems had grown far beyond a manageable level and years of work were required to recover.

We endorse ways to provide front-end financing to communities such as the prepayment of taxes and tax credits, and suggest that the Synthetic Fuels Corporation consider loan guarantees to local governments for expensive capital improvement projects needed to accommodate the additional residents brought in by a synthetic fuels project.

Getting and spending this money wisely requires an expertise about government planning and financing that few small town officials had. One county commissioner said that the numbers in the county budget "boggled his mind." If local governments were to deal adequately with the new level of problems they faced, all officials agreed that they had to hire professional staff—a move that was new in many of these communities, and a very difficult move to make.

Often local officials or their constituents felt that the local officials had been elected to run the city (or county) and that if they hired a professional person to do that, the elected official was shirking his or her responsibility. They were also quite often concerned about relinquishing power to an unelected official. Therefore, while the change to professional city and county management was essential, it was often a very difficult change to make.

Local government salaries represented another complicating factor. Before growth, many elected local government officials were unpaid or received token compensation, and town clerks or department heads were paid modest salaries. Prevailing salaries for professional government planners or managers were considerably higher. However, if a professional person was brought in at much higher pay than the long-time officials received, hard feelings and suspicion often developed. One solution to this problem is to increase the salaries of long-time officials, if not to equal levels, to a level sufficient to eliminate some of the hard feelings and distrust.

PLANNING

When communities grow rapidly, professional planning is an essential element of effective growth management. Comprehensive master planning, zoning, subdivision ordinances, and building codes are all needed for orderly growth. However, planning and zoning are dirty words in most small western communities, and government regulation of land use is considered by many to be an infringement on property rights. But as one planner described it, without county planning and zoning, subdivisions were thrown helter-skelter across the countyside. Rural sprawl, consisting of isolated residential developments scattered through unincorporated areas, caused many problems. Residents often expected urban services such as fire protection and snow removal that counties were not prepared to provide.

In one county, ranchers were strongly opposed to any form of county zoning. But when some ranches were subdivided for residential development, neighboring ranchers began to have problems with domestic dogs harassing their stock. Some of them are now beginning to recognize that certain restrictions on the individual's property rights may be needed to protect the welfare of others.

Industry: Many energy companies had good working relations with local government in rapid growth communities, especially when the community as a whole welcomed the growth. Other companies, however, had strained relations with the community in which they were operating. Often the strain occurred because of poor communication and misunderstanding between the company and community officials.

Companies must provide as complete and accurate information about their plans to local officials as they can. In that way, local officials can know what to expect and can plan accordingly. If an atmosphere of trust is established between local government and industry, the two can work together to solve most unanticipated problems that arise. This benefits both parties more than trying to ignore problems and hoping they will go away, which has been done sometimes by industry and government officials.

In Green River and Gillette, Wyo., formal mechanisms were developed for collecting information on industry's plans and making it available to the public. In Gillette this is done by the Chamber of Commerce Industrial Committee; in Green River it is done by the Southwest Wyoming Industrial Association. In the communities where no clearinghouse organization for industry was formed, local government officials and citizens had a much harder time obtaining accurate information.

However, local officials must recognize that making employment and population projections is difficult. This is especially true in the oil shale industry, which suffers from a higher level of uncertainty than most industries. Projections should be made in good faith, and when changes occur, they should be corrected in good faith. At the same time, local government officials need to understand that when industry projections turn out to be wrong, it does not automatically imply that the company lied. It more likely means that the assumptions on which the projections were based have changed.

Effects on employment: Many people expected that energy development would provide high-paying jobs for local people. This seldom happened in our resource communities. The energy companies paid well, but many of their employees were brought in from other areas, especially construction workers for powerplants. Even where skilled people were available locally, if they did not belong to the union, they often could not get jobs with the construction companies.

On the other hand, many of the construction people who came in did not leave the area when the construction of the first plant or plants was complete. Often they found other work in the area or commuted to other construction jobs, leaving their families in place. This meant that the population did not peak and then drop off as quickly as many people expected it would; rather it peaked and then leveled off at a level higher than would have been expected had all the construction people left.

Another effect of the high-paying energy company jobs was a great increase in the overall cost of living in the rapid growth community. Land values, rents, grocery prices—all prices went up so much that people on fixed incomes or minimum wage jobs found it difficult to make ends meet, although their income had been adequate before. Often women had to take jobs outside the home to stretch the family income. Women also went to work filling the secondary, minimum wage jobs that were abandoned by men who were able to get higher paying jobs with industry.

Effects on human services: Human service needs increased in rapid growth communities—that fact is clear. However, not all the needs were due to newcomers, or even to the changes in the community. Part of the increased demand for human services was due to the increased availability of human services. Often the communities began human service programs that were needed all along, but were not given a high priority until rapid growth came. Before growth, much help for people with problems was provided by informal networks—i.e., families, friends and neighbors—and not by formal institutions. Human services and education are two areas where communities frequently benefited from rapid growth. Growth made new facilities and services available that were not available before.

SUMMARY

Rapid growth has had both positive and negative effects on small communities. If people in rapid growth communities work together to prepare for the change, they can often direct the change to maximize the benefits and minimize the costs. However, if communities do not prepare for change, they often become victims of forces outside of their control, and are unable to manage the change in any effective way.

Many people in our resource communities were proud of the way the community had handled rapid growth, and many felt that, once the turmoil had decreased and the people had learned to work together to solve their problems, the community was a better place to live than it had been before. It is important to recognize that when community growth occurs at the rate and scale proposed by the synthetic fuels industry the resulting community will be completely different than the small rural town that was there before. I urge you to consider learning from the experiences of other communities that have gone through rapid growth.

We might mention the Kentucky delegation. I would encourage Kentucky to look at Colorado, Utah, and Wyoming. We saw two fine examples of industry cooperating this morning.

Thank you, Mr. Chairman.

Mr. FUQUA. Thank you very much, Dr. Carpenter.

Dr. Carpenter, what opportunities have you had to share the information that you had gathered with, say, the communities of western Colorado that are being impacted now, as indicated in earlier testimony, of Parachute and Rifle?

Dr. **Carpenter**. We have not worked in the oil shale communities. We are currently working in three other communities, one in western Colorado and up in the Over Thrust area in Wyoming, Cameron, and Star Valley. We are just concluding our 3-year project. Those have been demonstration communities. We hope at the end of June when the project concludes we will be able to work with some of the other areas.

Mr. **Fuqua**. Are you familiar with the activity that has been going on in Rifle and Parachute?

Dr. **Carpenter**. Peripherally, because we are not working directly in those communities. I am aware of some of the efforts that are going on.

Mr. **Fuqua**. Have you found industry to be receptive to your suggestions?

Dr. **Carpenter**. We have not offered any suggestions to them at this point, but I think from what you heard today you are seeing a new generation of cooperation and understanding exercised by both communities and the companies, and I think those are two very fine examples of what industry can do. Early in the 1970's it was not the case. We would not have been as likely to see that.

Mr. **Fuqua**. The work you have been doing has primarily been in western communities. We discussed earlier there is some difference between western communities and maybe some of the eastern ones; for instance, in Kentucky. Do you see the eastern communities as having a somewhat different impact than maybe western communities where more sparsely populated areas are? And how would you help eastern communities prepare for a sudden change in their socioeconomic environment?

Dr. **Carpenter**. I think many of the lessons that have been learned by the small rural western communities are applicable to eastern areas. The cooperation, the methods the communities have worked out to cooperate with industry are very important. Each of the four communities we worked with created a different system. In some cases Gillette, Wyo., organized a chamber of commerce to coordinate the flow of information and do the cumulative work on population figures and projections. In other cases they had priority boards or industrial associations.

I think there are so many interesting methods by which communities can cooperate so both industry and communities benefit, that it would be highly desirable for the eastern communities to look at that information and pick and choose. I think there is an attitude toward planning in some western communities, and in some western communities there is a resistance to planning. That may not be as true in the East.

You would want to look at the different attitudes but much of that can be transferred

Mr. **Fuqua**. Mr. Gottlieb, what is the Synthetic Fuels Corporation's attitude toward regions that might withhold permits until the locating companies promise to provide certain types of impact assistance?

Mr. **Gottlieb**. Well, the Corporation would give great deference to State and local officials, who act in their interest to assure there is appropriate mitigation and make these demands on companies and work them into the permit process.

I should add, if a company does not have a permit or it appears they cannot obtain a permit in timely fashion, under our criteria relating to regulatory compliance we would not give them assistance.

Mr. FUQUA. So they could be affected in their financing then?

Mr. GOTTLIEB. Absolutely.

Mr. FUQUA. Or in their loan guarantees?

Mr. GOTTLIEB. Absolutely.

Mr. FUQUA. Have you developed any criteria for projects yet?

Mr. GOTTLIEB. We have developed detailed criteria to evaluate all of the projects that are before the Corporation and as I indicated——

Mr. FUQUA. I am really speaking of the socioeconomic impact.

Mr. GOTTLIEB. Well, we have what you might call a checklist of individual items that come under the general rubric of the socioeconomic, which, you know, we review when we have the project information and the permits, and so on, available to us.

Mr. FUQUA. That would apply both to East and West impacts?

Mr. GOTTLIEB. That is correct.

Mr. FUQUA. Mr. Ihara, what is the role of the State of Kentucky, or Kentucky and company, in socioeconomic impact mitigation?

Mr. IHARA. Kentucky and company is very much concerned to try to encourage cooperation between the local communities, State government and the project sponsors. Our primary role has been to attempt to assess, provide technical assistance to the local communities, to assess what the tax implications, revenue implications are of these developments, and to coordinate State agencies in trying to address some of these problems.

I mentioned the technical committee that we have. Prior to that we had what we called a synthetic fuels task force, out of which this committee arose, which was comprised of the cabinet secretaries, so that at the highest level there was an awareness of the plans by the project sponsors, what they meant for the Transportation Department or our human services people, and so on, and that if any decisions were required, any critical issues were identified that required action by one or more agencies, that that knowledge was obtained at the highest level in those particular agencies.

It has now evolved to the technical committee where we have identified where the major impacts are such as transportation, and the technical ommittee now is attempting to implement decisions that have been made and address these problems.

That is the major thrust of our activities, the coordinative role, and to try to provide technical assistance and continuing assessments.

Mr. FUQUA. I have been reading your advertisements.

Mr. IHARA. I could tell.

Mr. FUQUA. Do you see any parallel between what is happening, and we have heard this morning in Colorado, as it might affect Kentucky?

Mr. IHARA. Yes, sir. As a matter of fact, several months ago the General Assembly was in session, and just prior to their official session a delegation from Kentucky went to Colorado and talked with local officials. We have looked very closely at the western situation, both how they attempt to handle impact at the local level as well as the State level, and tried to see how they handle planning, what kinds of legislation they had, and we have been looking at that situation for quite awhile in an effort to design something for Kentucky.

Mr. FUQUA. Mr. Walker?

Mr. WALKER. Thank you, Mr. Chairman.

I have heard discussed here today the use of loan guarantees, the use of company money to be put into projects, and so on, primarily to improve community infrastructures as a part of this.

Can you give us some idea as to how much might be peeled out of R&D money that would be appropriated by Congress to provide for this kind of community infrastructure rebuilding, or building?

Mr. GOTTLIEB. From the perspective of the Synthetic Fuels Corporation, our money is, generally speaking, not available for loan guarantees, price supports, and the like to support community infrastructure activities.

Dr. CARPENTER. It is a difficult figure to assess. So many of these communities, before the company comes, have deteriorated water systems which need to be replaced anyway. They have been around for 50 years. It is difficult to put a cumulative figure on all the different impacts, but you are talking about millions of dollars.

Mr. WALKER. Our committee is generally concerned with authorizing money for technological improvements, technology advancement. What I am trying to do is get some handle on how much of that money is going to get put into something which is totally nontechnological in nature and is really a socioeconomic building of one kind or another. I think it would be helpful for us to know, as a part of the decision process that we go through, just how much impact there is in the socioeconomic area in terms of funding.

Mr. Gottlieb, do I understand correctly, for instance, that any money Congress puts up in the Synfuels Corporation area could not go for infrastructure?

Mr. GOTTLIEB. As the statute is now written, that is correct.

Mr. WALKER. So anything which is done under the auspices of Synfuels Corporation has to be done out of the company's own funding?

Mr. GOTTLIEB. By and large that is true. This does not preclude State and local support to the companies.

Mr. WALKER. And, of course, anything which the Corporation would do, the Corporation would be able to write off on taxes; is that correct?

Mr. GOTTLIEB. I am not a tax expert.

Dr. CARPENTER. I am not a tax expert either, but one of the problems, as I understand it, with the tax credits is that as current legislation exists, in IRS tax credits come only at the time at which they were to be given. If people prepay, they do not get the tax credit in that year. They get it several years later and that has been a difficulty with industry. There is current legislation before Congress now to change that.

Mr. WALKER. Thank you, Mr. Chairman.

Mr. FUQUA. Let me thank the three of you for being here this morning. We appreciate your testimony and the work that you have put forth. We thank you very much.

[Whereupon, at 11:32 a.m., the subcommittee was adjourned, to reconvene subject to the call of the Chair.]

APPENDIX I

ADDITIONAL STATEMENTS SUBMITTED FOR THE RECORD

International Association
of
Bridge, Structural and Ornamental Iron Workers
Local No. 103
Affiliated with A.F.L.-C.I.O
PHONE 477-5317
5313 Old Boonville Highway - Evansville, Indiana 47715

STATEMENT BY

FREDERICK HITE
LOCAL 103
BRIDGE, STRUCTURAL AND ORNAMENTAL
IRONWORKERS UNION

BEFORE THE

ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE

OF THE

HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

APRIL 28, 1982

"SOCIO-ECONOMIC IMPACTS OF SYNTHETIC FUELS"

For submission into the record
of the subcommittee hearing
April 28, 1982
"Socio-Economic Impacts of
Synthetic Fuels."

Mr. Chairman; distinguished Members of the House of Representatives' Committee on Science and Technology.

My name is Frederick Hite. I am a member of the Bridge, Structural and Ornamental Ironworkers Union, Local 103 and I represent another group which is a coalition of the building trades in the western part of Kentucky, LABOR FOR COAL CONVERSION.

I would like to address myself, and the views of my organization, to the correct method experts should follow when they address the myriad of socio-economic impacts facing any community that plans to invite industry into its area.

I represent 20,000 men and women who believe that a synthetic fuels industry is a necessity for the national security of this nation. We find it appalling that President Reagan with his strong love for the national defense of this nation has seen fit to ignore this most vital link in our national security system.

Over 90 billion dollars of this country's money is going abroad to finance this country's love of the automobile. It's time to face the facts that we'll never wean this nation away from their means to mobility, so let's address instead where we are to get our future fuel needs and cut down on what we are sending abroad. This problem solved would reduce the national deficit considerably.

Let's go on to the problem this committee is addressing: socio-economic impacts of siting synthetic fuels facilities. Let me speak to a situation that is local and one that I can address knowledgeably -- the SRC-1 project proposed for Daviess County, Kentucky.

Page Two

Our area is the proposed site for 4 major synfuels projects. You can imagine the concern that stirred up with locals! Where will we put all the construction people? How will they get to the construction site? Do we have enough construction personnel to build these facilities? etc, etc.

Study after study began in a cooperative spirit on the socio-economic impacts of synfuels in our area. As representatives of the building trades, we were happy to do our part to supply figures to all parties which conducted these studies. Some of these included the U.S. Department of Energy, International Coal Refining Company (the parent company proposing to build the project), the Green River Area Development District, the Kentucky Center for Energy Research, and probably a few others I have forgotten to mention here.

All of those studies showed one thing: The area could easily accommodate one or two facilities with an added plus of a boom to the local economy (something we are in sad need of right now, I might add!) There were a few areas that were in question:

1) Could US Hwy 60 accommodate the influx of construction workers?
2) Would these plans cause a problem in the conversion of farmland to industrial use?
3) How could we deal with the removal of the plant site from the tax base for the construction period?
4) Do we have the labor to complete this work?

Heads far better than mine have addressed these problems but let me just give you my thoughts on each of these so-called problem areas.

1) Can US Hwy 60 accommodate the construction traffic?

Yes! Our area is a team spirit community. We need industry in our area and we will do what is necessary to attract people who can help us with our economy.

US 60 is a bad road. The Kentucky Department of Transportation has agreed to add a spur off the parkway to eliminate the problem as expressed in the EIS, the GRADD has offered to initiate a busing system to handle carpooling from urban areas into the plantsite and reduce traffic, and ICRC has agreed to work with both on staggering work schedules to fit within the community's needs.

So, do we have a problem? No! I think we have a community willing to work together to bring about a boost to our economy. We want to be the first area to help this country become energy self-sufficient.

2) Conversion of farmland to industrial use? Again, I am speaking to the facts developed by the SRC-1 Project as they are further along in their studies on the subject: The SRC-1 Project which would encompass 1486 acres would be displacing a mere .3% of the farmland in Daviess County. How many more acres would we displace if farmers could not get fuel for their tractors, fertilizer for their fields? Everyone would reap the benefits of these facilities with a secure fuel supply at a price on which we could count.

3) Labor shortage -- this topic can be dismissed pretty summarily. Our building trades have a whopping 50% unemployment now. Even if we were at a peak, we could easily build four of these facilities with staggered construction peak schedules. We have worked closely with the above mentioned planning entities to solve this hypothetical situation.

4) Removal of the site from the tax base -- Let's face it, the tax base isn't enjoying a big boom right now with so many people unemployed. No paychecks coming in, no taxes going out! Building permits which would be assessed during the construction period would total (for the SRC-1 project alone) over $1.5 million. I should think the local areas could use just a few of those dollars to put in the one or two extra firemen or policemen they would need because of the growth. After all, these plants would be taking the

place of farmland, not a high assessment now. All of these companies have been very willing to do their part in the community and they have indicated the willingness to talk with local government about other areas in which they could help. It is to their advantage to start out right ... what good does it do to go into a community with bad will? The people who will build these facilities and work at these facilities will come from this area. They will want the industry to do its part to make their homes and cities as livable as possible.

So, Mr. Chairman, it seems to me we've got a lot of plusses these facilities could bring to these areas, and very few problems. I know most of you will say we're just concerned about jobs. We are concerned about jobs. We want to work. But over and above that consideration, I think you people in Congress need to get your heads out of the ground and realize ENERGY is this nation's most important problem. I think I and a lot of other voters in the country had high hopes for the types of things we expected from this Congress and this President.

What happened to this nation's energy policy? We are back into the age-old American role ... if it's not an emergency let's put it on the back burner. We simply cannot afford to let this important issue sit on the back burner to go up in flames two days, two months, two years from now. We want action out of you.

We can work together to eliminate or ease the few socio-economic questions that may arise in building these energy facilities, but we can't produce our own energy supply overnight when the crisis comes. And the crisis will come -- I think you all know that. What will be our excuse then? What I urge you to do when examining these projects is communicate. Talk to the areas in which these facilities will be located. You'll be surprised how fast local initiative can take hold. Let me tell you it will be a darn sight faster than you people have been able to get your act together.

Locate this plant in areas for reasons advantageous to both the companies involved and the area citizens. It makes sense to look at water supply, coal supply, labor supply and transportation. It also makes sense to talk about preserving quality of life.

Let's not fool ourselves into thinking that's too monumental a task. We're doing it here. We're working together to get something we need. Don't talk a situation to death -- work with it, and we'll work with you. The people in Middle America are ready to be energy self-sufficient -- What about you here in Washington?

# # # # #

APPENDIX II

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

The Synthetic Fuels Industry in Kentucky:
An Assessment of Environmental Health Issues

Harry G. Enoch

February, 1981

Technology Assessment Division
Bureau of Energy Research
Kentucky Department of Energy
Lexington, Kentucky

Printed with state funds.

I. INTRODUCTION

The developing coal conversion industry in Kentucky can provide many important benefits for local communities and for the state. The plants will provide jobs and income for workers, increased levels of economic activity for businesses, and increased revenues for state and local governments. At the same time, this industry will make use of Kentucky's abundant coal resources and supplement the dwindling supplies of domestic oil and gas. In order to realize these benefits it is important to minimize any adverse effects on natural resources and society.

Although coal gasification and liquefaction have been practiced for many years, their development and commercialization in the U.S. will require overcoming significant technical and environmental obstacles. This development will not take place in the dark. On the contrary, it will be scrutinized by environmental scientists and activists, the various regulatory authorities, the popular press and the general public. Anticipation, planning and cooperation in the early phases of the industry's development will be necessary to guide efforts to reduce the health and safety risks and the costs to society.

The synthetic fuel plants proposed for western Kentucky may represent the largest commercialization effort and the most concentrated development of such facilities in the country. The Commonwealth of Kentucky, as a primary promoter of this industry, must share some of the responsibility for ensuring its environmental acceptability. The purpose of this paper is to identify and briefly discuss the major environmental health issues associated with the synfuel industry.

II. COAL CONVERSION TECHNOLOGY

Although the proposed gasification and liquefaction processes have not been practiced on a large scale in this country, there is considerable information on the environmental effects and health hazards anticipated for these technologies.

Coal conversion technology will require:

- the processing, handling, and storage of corrosive and toxic materials
- the application of highly sophisticated pollution control devices and good engineering practice
- the disposal of vast quantities of solid waste
- the handling and end use of a spectrum of new products of, as yet, unknown toxicological potential.

These technologies are based on relatively simple concepts (Figure 1). During the liquefaction process the complex molecular structure of coal (Figure 2) is altered from a high molecular weight solid to a heterogeneous mixture of liquid and gaseous hydrocarbons. The resulting substances in these mixtures include linear hydrocarbons, or paraffins (e.g., methane, ethane, propane, butane), aromatic hydrocarbons (e.g., benzene, toluene, xylene), and polyaromatic hydrocarbons (e.g., naphthalene, anthracene, pyrene). These substances are components of natural petroleums but appear in different proportions in synthetic mixtures. Hydrogen also reacts with the sulfur, nitrogen, and oxygen in the coal to form hydrogen sulfide, ammonia, and water, respectively.

In the gasification process the structure of coal is altered more dramatically - the carbon in coal reacts with steam to give carbon monoxide and hydrogen:

$$C + H_2O \rightarrow CO + H_2$$

Figure 1

SIMPLIFIED BLOCK DIAGRAM OF COAL CONVERSIONS PROCESSES

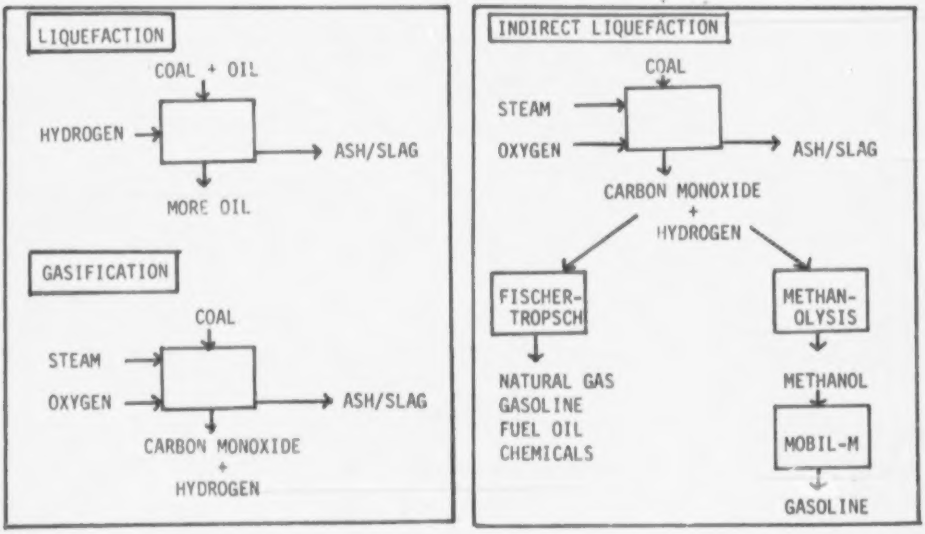
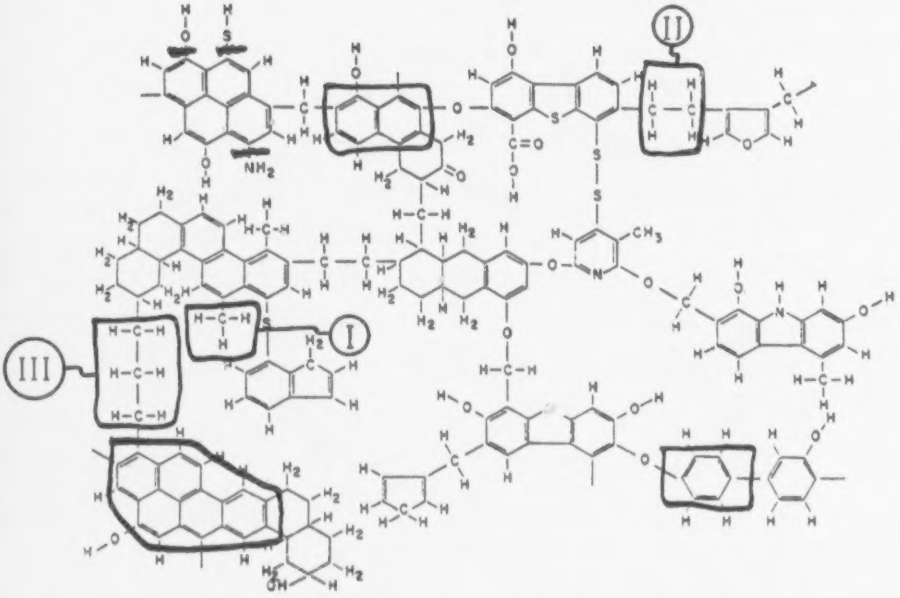

LIQUEFACTION
COAL + OIL
HYDROGEN
ASH/SLAG
MORE OIL
GASIFICATION
COAL
STEAM
OXYGEN
ASH/SLAG
CARBON MONOXIDE
+
HYDROGEN
INDIRECT LIQUEFACTION
COAL
STEAM
OXYGEN
ASH/SLAG
CARBON MONOXIDE
+
HYDROGEN
FISCHER-TROPSCH
NATURAL GAS
GASOLINE
FUEL OIL
CHEMICALS
METHANOLYSIS
METHANOL
MOBIL-M
GASOLINE

Figure 2

DIRECT LIQUEFACTION: HYDROGENATION OF COAL



The above figure shows the hypothetical structure of bituminous coal and the structure (in bold outline) of the products of hydrogenation. For example, I - methane; II - ethane; III - propane.

This mixture can be used as an industrial fuel gas or as synthesis gas. Synthesis gas can be converted to other gaseous fuels, e.g., methane or high Btu gas, and liquid fuels, e.g., methanol and gasoline.

Most of the process steps in a coal conversion plant have counterparts in conventional coal and petroleum technologies (Figure 3). The first step typically involves coal preparation; this area includes a number of familiar operations including coal receiving, storage, pulverizing, and feeding. Another familiar process is coal combustion in a boiler which provides process steam and electricity. The bulk of the plant's air emissions may come from this single point source (Figure 4). Following the gasification or liquefaction steps the process stream is then subjected to clean-up, upgrading, purification, and storage of products using technology adapted from the petrochemical industry. There are many similarities also with the kinds of problems which are routinely and successfully faced in conventional chemical process plants, such as, the handling of toxic materials at high temperatures and pressure, the potential for release of poisonous gases, exposure to pollutants, fire, explosion, and accidents.

III. ENVIRONMENTAL STANDARDS AND CONTROLS

The synthetic fuel plants must be built in compliance with numerous environmental statutes and regulations (for example, see Figure 5). Although performance standards have not yet been developed specifically for these plants, the standards for new coal-fired boilers and petroleum refineries will be applicable. The requirement for the use of best available control technology will ensure that emissions to the air and water are treated and that

FIGURE 3

PROCESS AREAS OF AN INDIRECT LIQUEFACTION FACILITY

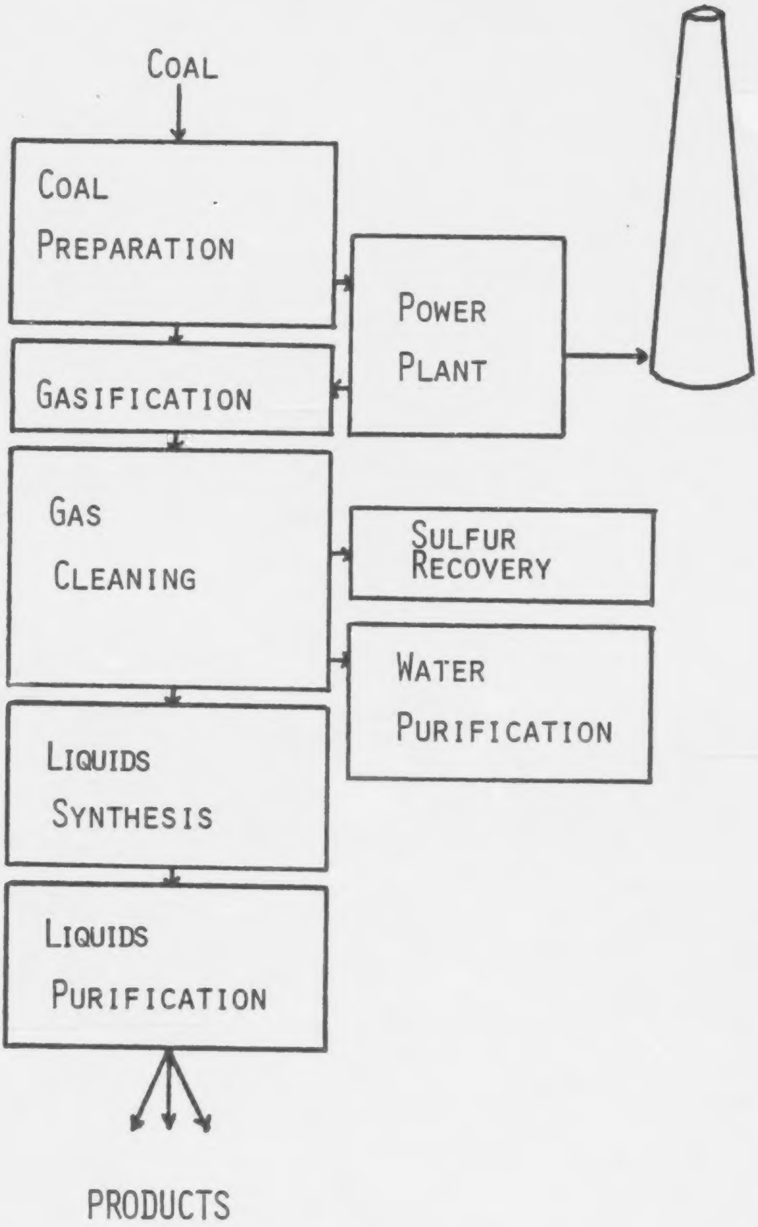

COAL
COAL PREPARATION
POWER PLANT
GASIFICATION
GAS CLEANING
SULFUR RECOVERY
WATER PURIFICATION
LIQUIDS SYNTHESIS
LIQUIDS PURIFICATION
PRODUCTS

FIGURE 4

THE CONTRIBUTION OF BOILER FLUE GAS TO AIR EMISSIONS FROM A COAL TO METHANOL TO GASOLINE PLANT

Sulfur Dioxide	97%
Particulate Matter	96%
Nitrogen Oxides	85%
Carbon Monoxide	9%
Hydrocarbons	31%

SOURCE: Badger Plants, Inc. Conceptual Design of a Coal-to-Methanol-to-Gasoline Plant. Volume III Environmental, March 1979.

FIGURE 5

FEDERAL ENVIRONMENTAL LAWS APPLICABLE TO COAL CONVERSION FACILITIES IN KENTUCKY

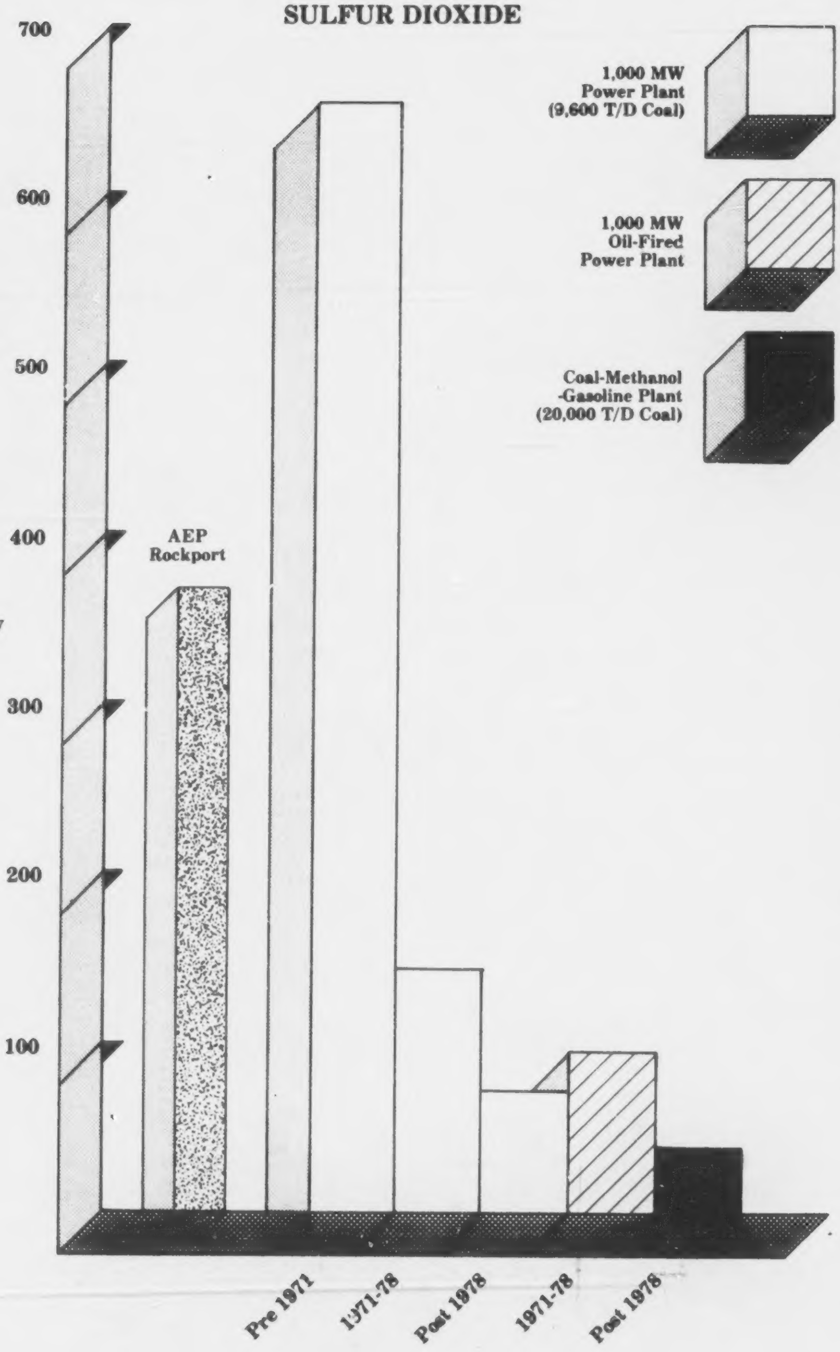
Clean Air Act
Clean Water Act
Safe Drinking Water Act
Toxic Substance Control Act
National Environmental Policy Act
Resource Conservation and Recovery Act
Occupational Safety and Health Act
Endangered Species Act
Noise Control Act
Rivers and Harbors Act
Fish and Wildlife Coordination Act
National Historic Preservation Act
Wild and Scenic Rivers Act
Non-nuclear Energy Research and Development Act
Surface Mining Control and Reclaimation Act
Executive Order 11988 - Flood plain Management
Executive Order 11990 - Protection of Wet lands

contaminants are reduced to levels that comply with health and welfare standards. A number of studies and reports by the U.S. DOE, EPA and others have concluded that existing technologies should be sufficient for the control of potential synfuel pollutants.[1-6] In fact, synfuel plants should have lower emissions of sulfur oxides, nitrogen oxides, and particulates than comparably-sized new power plants, on a coal input basis (Figures 6-8). New power plants built under 1978 standards, in turn, will have much lower emissions than existing power plants, even those firing oil. Similarly, advanced water treatment techniques should allow aqueous contaminants to be reduced to levels which will meet water quality standards.[7] Where feasible, all waste water will be recycled in the plant and there will be no routine effluents (zero discharge).

The disposal of the large quantities of solid waste may be the most significant environmental challenge facing the synthetic fuels industry. But here also, present technology appears adequate to satisfy the most stringent criteria. The hazardous waste regulations promulgated recently under the Resouce Conservation and Recovery Act should ensure proper management of toxic waste materials.[8] Preliminary indications are that the bulk of the solid waste from synfuel plants (boiler ash, gasifier slag, and flue gas desulfurization sludge) will not fall into the category of hazardous wastes.[9,10]

The present environmental standards will require adoption of the most advanced pollution control technology. The regulations in effect today also include monitoring and reporting requirements that will ensure that plants are operated in compliance with permit conditions. Another set of standards and rules will ensure that no emissions will be allowed to cause a significant degradation of existing air quality or to contribute to existing air quality problems. Ambient air quality standards have been set for the priority pollutants, those pollutants thought to have

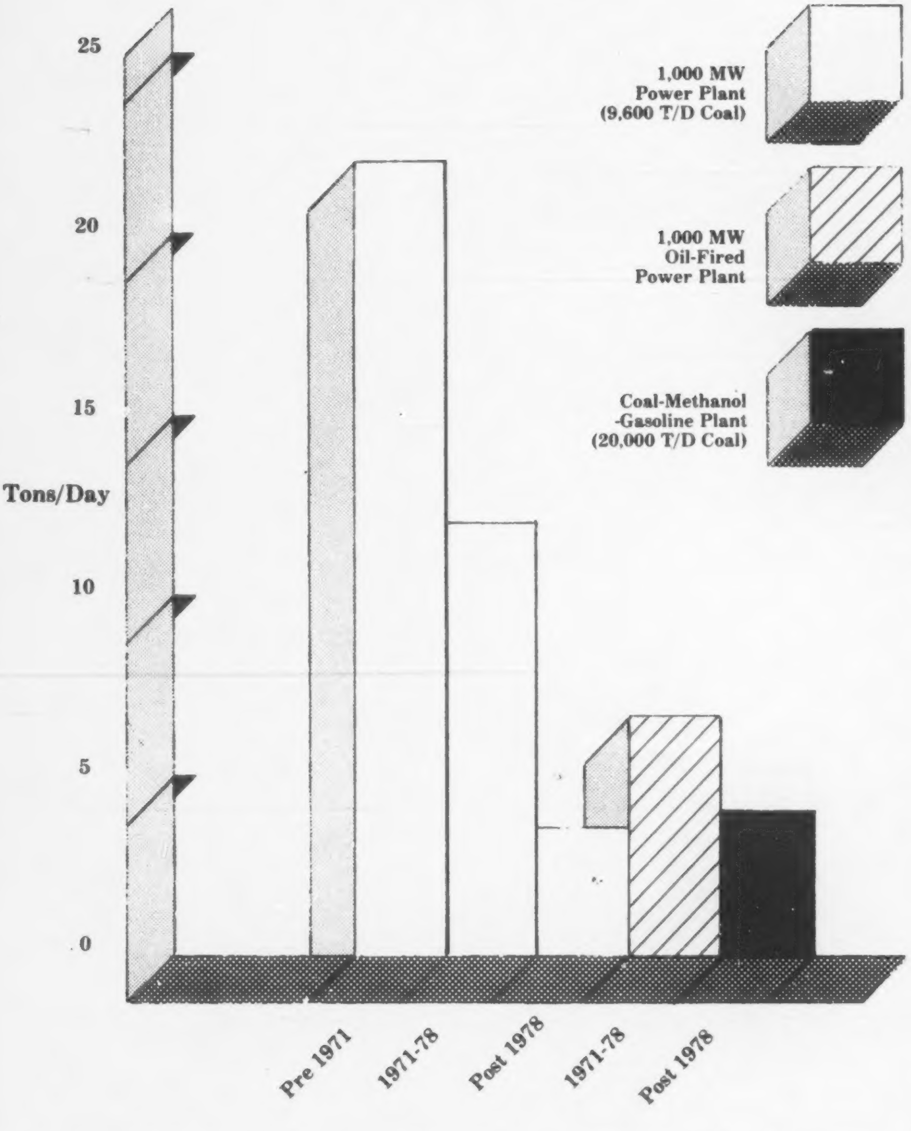
Figure 6



Comparison of Emissions From a Typical Synfuel Plant with Those of Old and New Power Plants

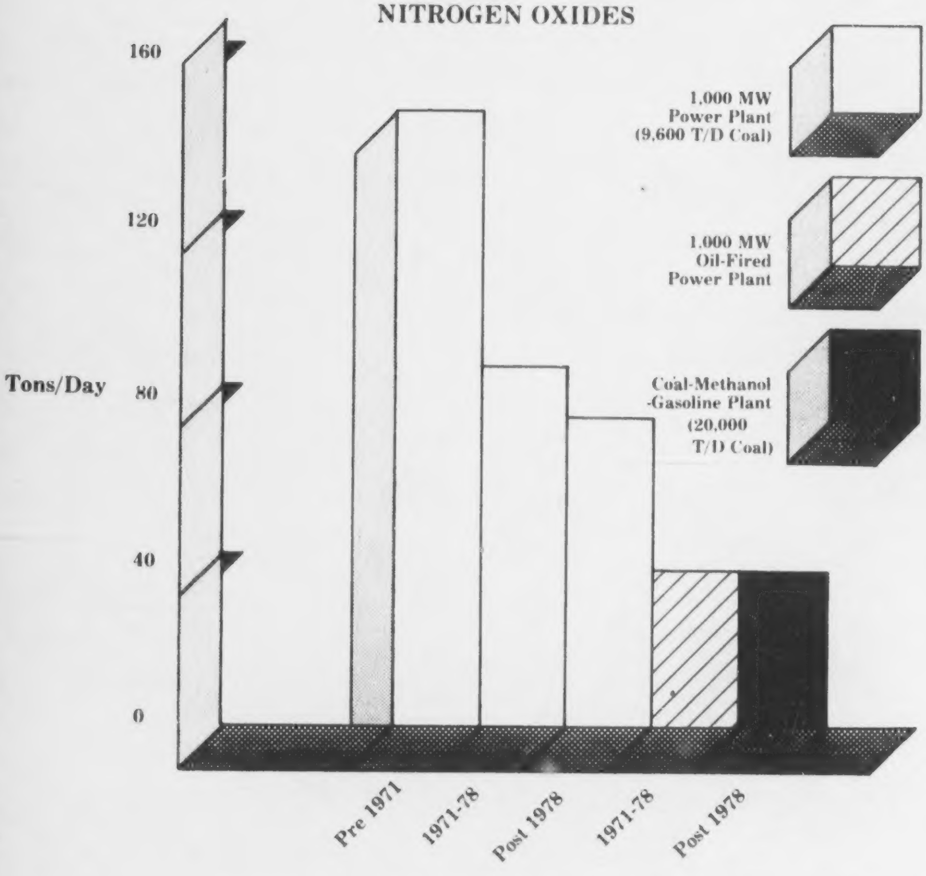
Figure 7

PARTICULATES



Comparison of Emissions From a Typical Synfuel Plant with Those of Old and New Power Plants

Figure 8



Comparison of Emissions From a Typical Synfuel Plant with Those of Old and New Power Plants

the most potential for effects on human health and welfare: sulfur dioxide, nitrogen oxides, carbon monoxide, photochemical oxidants, particulate matter and lead. No plant or combination of plants will be allowed to violate these standards (i.e., the permits to construct and operate cannot be issued unless the applicant can demonstrate compliance, under worst-case conditions, with all laws and regulations). A parallel set of standards and rules are in effect for water quality.

IV. PUBLIC HEALTH

A. Environmental Carcinogens

Environmental carcinogens* have emerged as one of the dominant health concerns in regard to the coal conversion industry. There are several reasons for this. It has become widely accepted in the last few years that many human cancers may be caused by environmental factors.[11] Such factors are thought to include:

- exposure to sunlight
- smoking
- alcohol
- diet
- occupational hazards

Since these factors are controllable, it is also thought that most cancers might be preventable. The mechanism of cancer initiation remains poorly understood. It is known, however, that cancer can be induced by the exposure to certain natural and man-made agents. These agents include, for example:

- ultraviolet light
- ionizing radiation (e.g., X-rays)

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*Carcinogen - any substance that can produce cancer.

- asbestos fibers
- soot, coal tar, mineral oils
- fungal toxins (in food)
- metals (e.g., nickel, chromium, arsenic)
- organic chemicals (many natural and synthetic compounds)

A number of different types of cancers have been traced to specific occupational exposures and, in a number of cases, the specific carcinogenic agents have been identified (examples are vinyl chloride, asbestos, and β-naphthylamine). Investigations have thus far failed to find any increased risk to the general public (nonoccupational) associated with the production or release of carcinogenic materials from industrial processes.[12-14]

A number of carcinogens have been identified in coal conversion products and process materials. Although the exact compositions vary with the process and the feedstock, the materials of concern will include:

- trace metals from the mineral matter in coal,
- benzene
- polycyclic aromatic hydrocarbons, PAH (high molecular weight aromatic hydrocarbons, e.g., benzo(a)pyrene)
- aromatic amines.

The release of trace metals can be largely prevented by the control of particulate matter, the major source of these metals. This technology is well advanced and is capable of 99.5% control. Benzene is very volatile and its release can be prevented by evaporative emission controls (floating roofs and vapor recovery systems on storage tanks, double seals on compressors and pumps, leak detectors, scheduled maintenance, and requirements for repair record keeping and reporting). The PAH and aromatic amines may present the greatest potential problem by their presence in trace amounts in the products;

in stack emissions from boilers, heaters, and flares; in fugitive emissions*; and in accidental and emergency releases. However, state-of-the-art technology and good operating practice are capable of preventing significant amounts of these materials from getting into the atmosphere,ground water, and surface water.

The formation of PAH's are not unique to coal conversion processes. These compounds are commonly found in the products of combustion of all organic matter. As a general rule, the more inefficient the combustion the more PAH's are formed. Benzo(a)pyrene continues to be the most widely accepted indicator of PAH content and biological significance.[12] Estimates of the major sources of benzo(a)pyrene in the U.S. are shown in Figure 9. Residential furnaces (coal and wood) are the largest source, while coal-fired utilities and petroleum refineries, which are more representative of coal conversion processes, are relatively minor sources. However, coal conversion liquids contain at least 3 times the level of benzo(a)pyrene as crude petroleum and coal tars may contain similarly higher levels than petroleum tars[15] - indicating that a higher degree of caution is needed in regard to these processes.

There has been considerable debate whether additional regulations are needed to control public exposure to carcinogens produced by synfuel plants. Several areas are presently controlled:

- product handling, transport, and end use by the Toxic Substances Control Act
- waste disposal by the Resource Conservation and Recovery Act
- "best available control technology" is required by the Clean Air Act under the rules for Prevention of Significant Deterioration

---

*Fugitive emissions - means emissions that do not usually pass through a stack or vent such as leaks, diffuse releases, and emissions from indirect sources such as roads, farming, and mining.

Figure 9

ESTIMATED BaP EMISSIONS IN UNITED STATES, 1975

Source Category	Emissions (metric tons/year)
Heat and Power Generation	
Coal	
Residential furnaces	26
Intermediate units (commercial)	<1
Steam power plants	<1.
Oil	2.7
Gas	1.0
Wood	73
Refuse Burning	
Enclosed incineration	2
Open-burning	
Coal refuse fires	50
Forest and agricultural fires	11
Other (vehicle disposal; domestic, commercial & industrial burning)	unknown
Industrial	111*
Vehicular (tire degradation, exhaust emissions, etc.)	13
TOTAL	292

*Coke ovens account for an estimated 110 tons of BaP per year.

SOURCE: R.B. Faoro and J.A. Manning, Trends in Benzo(a)pyrene, 1966-1977, Journal of the Air Pollution Control Association, Vol. 31, pp. 62-64, 1981.

- specific performance standards are required under the Clean Air Act and Clean Water Act.

The last area may not be totally adequate until new source performance standards are adopted for specific synfuel technologies. These are being developed at this time by the U.S. EPA, but are still several years away. Until then the standards for coal preparation plants, coal-fired boilers, petroleum refineries, and chemical process plants will be used as applicable.

There are at present no ambient air standards for carcinogenic substances. The reason for this is simple: there is insufficient evidence to allow "safe" levels of such substances to be predicted. In fact, the no-threshold linear dose-response theory predicts that there are no safe levels and that any exposure to carcinogens will contribute to an increased cancer risk. The risk assessment of carcinogens is complicated by the fact that a disease state may not result until many years (20 or more) of exposure. The picture is further complicated by the presence of numerous natural carcinogens in the environment. Numerous research laboratories are working to provide information bearing on these questions. This will lead to the development of techniques to estimate dose-dependent human risks based on experimental studies (including epidemiology, animal tests, and so on). It may not be possible to guarantee absolute safety (zero risk) even at very low levels of exposure to carcinogens. Since zero risk is not an option, acceptable levels of risk can and must be identified.

An estimate of carcinogenic emissions (benzo(a)pyrene) from synfuel plants and a discussion of the resulting public health risk can be found in the Appendix.

If synthetic fuel plants, with the potential for producing carcinogenic emissions, are to be built during this period in the absence of emission standards, there are a number of things that need to be done:

1. Plant design and selection of control technology must consider the potential for carcinogenic emissions.
2. Estimations of the nature and quantity of potentially carcinogenic emissions must be made for various operating conditions and some type of approximated worst-case condition. These quantities should be compared to the quantities of similar emissions from conventional technologies for which the public hazards can be compared. As an example, the estimated yearly emissions of hydrocarbons from the SRC-I demonstration plant (60 tons[35]) are roughly equal to the emissions from 9 gasoline service stations.[16]* While this level of emissions may not be "safe", at least it may be compared to present levels of public exposure. Clearly, however, the composition of the hydrocarbon emissions from the SRC-I plant must be known before definitive comparisons can be made in this case.
3. Although present requirements are unclear, plant emissions should be extensively monitored, both on and off site, for those classes of substances which pose the highest carcinogenic risk.
4. Research should continue in order to allow early resolution of questions relating to plant emissions (their biological effects and their control) and product end use.

If these results are obtained in a timely fashion, prevention of adverse effects on public health can be ensured.

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*Based on service stations marketing 50,000 gallons of gasoline per month.

B. Other Potential Pollutants

As with any complex chemical process, the coal conversion industry must control numerous toxic substances within the plant and prevent their release into the environment. Many of these potential pollutants have been identified for coal liquefaction and gasification processes (Figure 10). The list is long and involves many toxic compounds. This was expected and is the case for many industrial processes. In fact, a list of potential contributors to indoor air pollution appears about as complex (Figure 11) and may actually be of greater concern due to (a) the hazardous nature of the pollutants, (b) the greater amount of time spent indoors, and (c) the decreased turnover of indoor air due to conservation measures.

Most of the pollutants in synfuel plants would result from low level emissions (0 to 50 feet above ground level) and, thus, would be a threat to the health of workers before that of the general public. Workers must be protected from these substances by occupational health standards, improved industrial hygiene and monitoring techniques, health surveillance programs, and strict work practices.

One additional concern involves secondary pollutants. Plant emissions, the primary pollutants, may undergo physical change or chemical reaction downwind from the plant and be transformed into secondary pollutants. For example, sulfur dioxide and nitric oxide can be converted into sulfuric acid and nitric acid, respectively. Analysis of these two specific secondary pollutants, which are the major contributors to acid precipitation, shows that the contribution from a synfuel plant in western Kentucky (or even the entire synfuel industry) would be small compared to existing sources (see Figure 12).

Figure 10

Potential Toxic Pollutants At
Coal Conversion Plants

Category	Example
1. Polynuclear aromatics	Benz(*a*)anthracene Benzo(*a*)pyrene Benzo(*b*)fluoranthene Benzo(*e*)pyrene Chrysene Dibenzo(*a*,*h*)pyrene Indeno(1,2,3-*cd*)pyrene Dibenz(*a*,*h*)anthracene Dibenzo(*a*,*l*)pyrene 7,12-Dimethylbenz(*a*)anthracene
2. Polynuclear aza-heterocyclic compounds	Benz(*c*)acridine Dibenz(*a*,*h*)acridine Dibenz(*a*,*j*)acridine
3. Aromatic amines	1-Naphthylamine 2-Naphthylamine
4. Nitrosamines	
5. Trace elements	Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Iron Magnesium Manganese Mercury Nickel Phosphorus Selenium Strontium Tellurium Vanadium
6. Particulates	Organic solubles Particle sizing Respirable and total particulates
7. Gases	Ammonia Arsine Carbon dioxide Carbon disulfide Carbon monoxide Carbonyl sulfide Carbonyls Cobalt Hydrogen cyanide Hydrogen sulfide Iron Nickel Nitric oxide Nitrogen dioxide Sulfur dioxide Thiophene
8. Other organics	Aldehydes Benzene Cresols Mercaptans Methyl thiophene Toluene Xylenes

SOURCE: J. Evans and B. Pallay in "Environmental Aspects of Fuel Conversion Technology, IV", Environmental Protection Agency, September 1979

FIGURE 11

POTENTIAL TOXIC INDOOR AIR POLLUTANTS

Aerosols
Ammonia
Asbestos
Benzo-a-pyrene
Biologic Factors
Carbon Dioxide
Carbon Monoxide
Chlorine/Hydrogen Chloride
Dust
Fluorides
Formaldehyde
Halogenated Phosphates
Halogenated Hydrocarbons
Lead
Mercury
Natural/Manmade Fibers
Nitrates
Nitrogen Dioxide
Nitrogen Oxides
Nitrosamines
Odors
Organic Vapors
Ozone
Petroleum Distillates
Polycyclic Aromatic Hydrocarbons
Radon/Radon Daughters
Respirable Suspended Particles
Sulfate
Sulfur Dioxide
Sulfur Oxides
Tetrachlorethylene
Tobacco Smoke
Total Suspended Particulates
Trace Elements
Viable Particles
Vinyl Chloride

SOURCE: taken from Inside E.P.A., August 15, 1980.

Figure 12

Effect of a 1,000,000 Barrel per Day Synfuel Industry on the Emissions of Potential Acid Rain Precursors (Sulfur Dioxide and Nitrogen Dioxide)

Total U.S. Emissions		
SO_2	30,000,000 tons/year	
NO_2	25,500,000 tons/year	
50,000 Barrel/day Coal Liquefaction Plant		
SO_2	14,500 tons/year	(<0.05% of U.S.)
NO_2	14,500 tons/year	(0.05% of U.S.)
1,000,000 Barrel/day Industry: 20 Coal Liquefaction Plants		
SO_2	290,000 tons/year	(< 1% of U.S.)
NO_2	290,000 tons/year	(1% of U.S.)

Another secondary pollutant which is a concern in western Kentucky is ozone, due to the fact that several violations of the standard have been recorded in the Owensboro-Henderson-Evansville area in the last few years.[17] Ozone results from the interaction of sunlight with nitrogen oxides and hydrocarbons. The prediction of atmospheric ozone levels from emission levels of nitrogen oxides and hydrocarbons is a complex problem with no presently acceptable solution. The latter two compounds are both emitted from synfuel plants. Methodologies for predicting ozone levels are now being developed.

V. OCCUPATIONAL HEALTH AND SAFETY

Occupational effects have generally received more attention than public health effects since workers in synfuel plants will be exposed to higher doses of any toxic material present and would be more likely to develop adverse health effects than the general population.[18] Furthermore, previous experience within the coal conversion and related industries indicates that these workers may have an increased risk for cancer, primarily of the skin, but possibly also for lung, bladder, stomach, and liver, if precautions are not taken.[19,21] Epidemiology studies in the U.S. and abroad have shown that workers in the oil shale industry[20] and coke ovens[21] had higher cancer rates than the general public. In times past little or no attempt was made to control emissions or limit worker exposure in those industries. In some cases, industrial exposure to known carcinogens has been extraordinarily high (Figure 13). The 9,000-fold higher exposure of coke oven top-side workers to benzo(a)pyrene has been associated with a 10-fold higher relative risk for lung cancer.

In a study of 359 workers at a coal liquefaction plant at Institute, West Virginia, an increase of 20 times the expected numbers of skin cancers was

FIGURE 13

Influence of Occupational and Other Factors upon BaP intake

Factor	BaP Intake (μg/day)	Cigarette equivalents (packs/day)
Smoking one pack of cigarettes each day	0.4	1
Coke oven workers		
Top side exposures	180	450
Side and bench exposure	70	175
Coal tar pitch worker	750	1,875
Airplane pilots		
Transatlantic flights	0.93	2.3
Domestic cross country	1.38	3.5
Employee in restaurant	0.8	2
Person living near expressway 24-hr/day (adverse meterology)	0.02	0.05
Commuter on an expressway 2-hr/day (adverse meterology)	0.04	0.10
Exposure to ambient BaP levels 8-hr/day	0.02	0.05

BaP - Benzo(a)pyrene

Source: Bridbord, et al. (1976) in "Carcinogenesis - A Comprehensive Survey" Volume 1, p. 319.

noted among the workers based on the rates in the general population. [22] All of the skin cancers were among operations or maintenance workers. The National Institute for Occupational Safety and Health (NIOSH) did a follow-up study on these employees and no unusual incidence of disease outside the initial skin lesions was found and none of the workers had died from cancer. [23] The Institute facility was operated from 1952 to 1959. Subsequent pilot plant operations have employed stringent control measures and worker protection practices. Studies at these other plants in the U.S. have not uncovered any work-related cancers.[24]

The Lurgi gasification facility at Sasol, South Africa has been in operation since 1952. NIOSH made a site visit to this facility in 1977. In conjunction with their survey of the plant, evidence was sought for skin cancer and chronic lung disease (chiefly through employee interviews). Skin problems were a common complaint (e.g., dermatitis) and there were several cases of skin cancer. There was no indication of an excess of cancer or any other disease prevalence,[25] although a definitive study was not performed. Since employee medical records going back at least 20 years are available at Sasol, it would be worthwhile to do an epidemiology study there as soon as possible. Such a study is planned by the U.S. DOE/NIOSH for the Lurgi gasification facility in Yugoslavia (expected in 1981). [1]

In order to advance from the pilot plant stage to the commercial stage of the coal conversion industry, considerable research needs to be performed at the pilot plants to provide guidance for the engineering design that will assure protection from process materials, emissions, and products. Health research programs are being carried out at two liquefaction facilities: SRC at Ft. Lewis, Washington and H-Coal at Catlettsburg, Kentucky. [26,27] A similar program is underway at a gasification facility in Duluth, Minnesota.[28] These comprehensive programs address the following critical issues:

- source assessment - detailed chemical and physical analysis of process streams, emissions, effluents, waste materials and products
- health effects - analysis of systemic, dermal, pulmonary, and genetic effects of toxic substances
- occupational exposure - extensive area and personal monitoring to determine worker exposure to toxic substances.

This is being combined in the pilot plants with

- worker education - to inform workers of the nature of the risks and the methods for minimizing risks
- industrial hygiene practices - keeping the plant and worker "clean" to reduce exposures
- work practices - experience will show how jobs can be performed to minimize exposure
- medical surveillance - to ensure early detection of health effects.

These measures will help to insure the continued good health of workers in coal conversion plants and allow early identification of any health problems that do develop.

VI. CONCLUSION

Existing technology is capable of preventing adverse effects on public health and welfare from the conventional air and water pollutants that will be generated in synfuel plants. The major health issue in regard to the coal conversion industry may be the potential for exposure of workers and, to a lesser extent, the public to cancer-causing substances. The commitment to the development of this industry must be accompanied by a continuing commitment 1) to address this difficult issue in a straightforward manner, 2) to assess the qualitative and quantitative nature of the hazards involved, and 3) to act promptly to apply any necessary control measures. Such a commitment could serve as the minimal basis for demonstrating environmental responsibility and could be essential for gaining public acceptance of the industry.

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VII. APPENDIX -

Polycyclic Aromatic Hydrocarbon Emissions from Synfuel Plants and Their Public Health Implications

Only a limited amount of data concerning emissions of polycyclic aromatic hydrocarbons is available at this time. Most work in this area has focused on industrial sources[12,13,29,30] including coal-fired power plants.[31] Recent studies have drawn attention to the emissions from the residential combustion of coal[32] and wood.[33] It can be seen from the data in Figure 14 that residential stoves and fireplaces emit benzo(a)pyrene at much higher rates than power plants. This is due to their lower combustion temperature and efficiency. Wood stoves, though often spoken of as being very "efficient", actually burn in an oxygen deficient environment, which leads to incomplete combustion. Stoves are efficient heat exchangers, not combustors. Increased use of wood for home heating has already led to air pollution problems in certain areas of the U.S.[34] and further increases could lead to some restrictions on the use of residential stoves and fireplaces.

Very little information is available on the quantity of carcinogens released from synfuel plants, although numerous studies are underway to gather this needed data. At this point it is possible to make some very conservative worst-case estimates for such emissions. For example, an estimate of the total hydrocarbon emission rate has been made for the SRC-I demonstration plant.[35] A total of about 60 tons per year of hydrocarbons is expected; this is largely accounted for by fugitive emissions including leaks. To get a worst-case benzo(a)pyrene emission rate one could assume that the hydrocarbon emissions have the same composition as the most contaminated hydrocarbon stream in the process. The highest concentration of benzo(a)pyrene reported

Figure 14

COMPARISON OF EMISSIONS FROM RESIDENTIAL HEATING
AND POWER GENERATION*

Source	Carbon Monoxide	Nitrogen Oxide	Sulfur Oxide	Particulate Matter	Benzo(a)pyrene
Residential Space Heating					
Gas	0.02	0.08	0.0006	0.02	30
Oil	0.04	0.09	0.3-7.0	0.07	900
Coal	3.5	0.1	0.5-7.0	0.6	2,500,000
Wood:Fireplace	3.0	0.25		1.3	45,000
Wood:Stove	22	0.07	0.03	1.2	135,000
Power Generation					
Coal#	0.00002	0.6	0.6	0.03	.37

*In $lb/10^6$ Btu of fuel except benzo(a)pyrene is $\mu g/10^6$ Btu

#Pulverized coal, tangentially-fired boiler.

SOURCE: Cooper, J. Air Pollution Control Association, August 1980 and S.G. Zelenski et al., Inventory of Organic Emissions from Fossil Fuel Combustion for Power Generation, Electric Power Research Institute Report EA-1394, April 1980.

in a coal liquid is 79 ppm.[36] This leads to a calculated value of 9 pounds of benzo(a)pyrene emissions per year (60 tons/year x 79/1,000,000 = 0.0047 tons/year). The significance of this amount may be judged by comparison with other sources. Simply burning the same amount of coal in a power plant (2 million tons/year) would result in the release of 30 pounds of benzo(a)pyrene each year (based on data in Figure 14) - more than 3 times greater than for the SRC-I demonstration plant. And it should be recalled from Figure 9 that power plants are not among the major sources of benzo(a)pyrene emissions. The 9 pounds per year should represent an overestimate because:

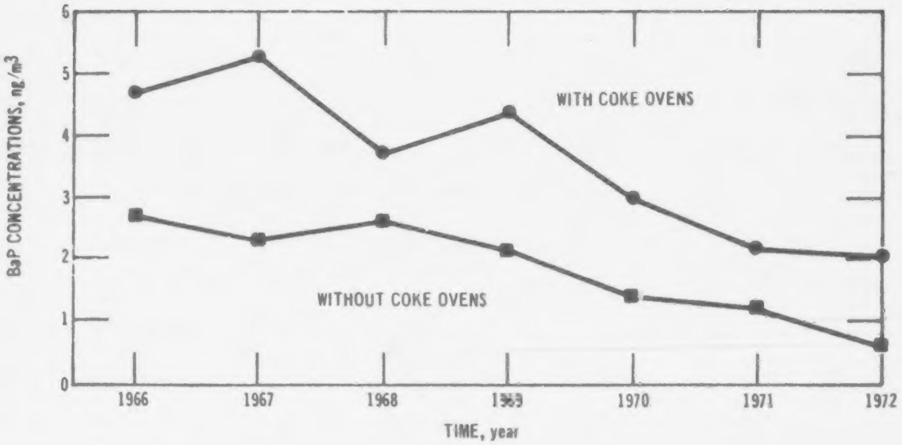
i. the composition of benzo(a)pyrene in many process streams will be lower than 79 ppm,

ii. hydrocarbon leaks consist mainly of gases, whereas the polycyclic aromatic hydrocarbons are solids (the melting point of benzo(a)pyrene is 354° F), and

iii. for the same reason, polycyclic aromatic hydrocarbons make only a minor contribution to evaporative emissions of hydrocarbons.

It is not clear that even the major sources of benzo(a)pyrene emissions have had any effect on public health, in spite of the fact that benzo(a)pyrene is a potent carcinogen. For example, coke ovens have been major emitters of benzo(a)pyrene - 65 plants emitted approximately 170 tons of benzo(a)pyrene in 1972[30] which was about 2.6 tons per plant (over 500 times more than calculated for the SRC-I demonstration plant). These emissions contributed to ambient levels of benzo(a)pyrene in the atmosphere which were measureably higher in coke oven cities than in non-coke oven cities (Figure 15). This difference has been maintained for a number of years, although there has been a trend toward decreasing levels in each. In spite of this difference, there is no trend toward higher cancer rates in cities with coke ovens: of the 34 cities with coke ovens, 17 had lung cancer rates higher than the national average and 17 had lower rates

Figure 15



Trends in annual BaP concentrations in cities with and without coke ovens.

SOURCE: U.S. EPA, POM-Preferred Standards Path Report for Polycyclic Organic Matter, October 1974.

(Figure 16). This data could be explained if concentrations of benzo(a)pyrene in coke oven cities (average of 0.002 $\mu g/m^3$ in 1972), although higher than in non-coke oven cities, are still low in comparison to levels associated with significant increased health risks. Such a risk has previously been associated with work in uncontrolled coke oven plants: workers at the top of coke batteries have been exposed to benzo(a)pyrene levels of 216 $\mu g/m^3$ for 8 hours a day.[12] This level of exposure was associated with a 10-fold higher lung cancer risk in these workers.[20] By extrapolation, the risk to the public of exposure to 0.002 $\mu g/m^3$ would be very small.

One of the drawbacks in the above analysis is the fact that benzo(a)pyrene is used to represent a whole spectrum of potential organic carcinogenic emissions. This was done because almost all of the emissions data and air monitoring data is available only for this compound. It may be appropriate in this case since benzo(a)pyrene is one of the most potent in its class of carcinogens and is a major carcinogen in coal liquids and tar. It is frequently used as a marker for the presence of other polycyclic aromatic hydrocarbons. Also, techniques that are designed to control the release of benzo(a)pyrene should control the release of other polycyclic aromatic hydrocarbons as well, due to their overall similar properties. Nevertheless, the limitations implied by such an analysis need to be further examined.

Figure 16

Lung Cancer Rates in Metropolitan Areas with Coke Ovens*

Above Average Rates			Below Average Rates		
1.	Tyler, TX	52	18.	Terre Haute, IN.	40
2.	Birmingham, AL.	52	19.	Indianapolis, IN	40
3.	Baltimore, MD	51	20.	Ashland, KY - Huntington, W.VA	38
4.	Houston, TX	49	21.	Lorain-Elyria, OH.	35
5.	Toledo, OH.	47	22.	Gadsden, AL.	35
6.	St. Louis, MO	46	23.	Hamilton-Middletown, OH.	35
7.	Buffalo, NY	45	24.	Canton, OH	34
8.	Philadelphia, PA.	44	25.	Duluth, MN - Superior, WI	34
9.	Erie, PA.	43	26.	Youngstown-Warren, OH.	33
10.	Wheeling, W.VA.	43	27.	Milwaukee, WI.	33
11.	Chattanooga, TN	43	28.	Bethlehem - Allentown - Easton, PA	32
12.	Detroit, MI	42	29.	San Bernadino - Riverside - Ontario, CA.	32
13.	Chicago, IL	42	30.	St. Paul-Minneapolis, MN	31
14.	Cleveland, OH	42	31.	Pueblo, CO	30
15.	Gary - Hammond - East Chicago, IN	42	32.	Tuscaloosa, AL	28
16.	Pittsburg, PA	41	33.	Johnstown, PA.	27
17.	Steubenville, OH - Weirton, W.VA	41	34.	Provo, UT.	15

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*Rates - deaths per 100,000 population - are for malignant neoplasms of trachea, bronchus, and lung in white males in 1959-61. The average rate for 201 Standard Metropolitan Statistical Areas was 40.79. Data are taken from U.S. DHEW, United States Metropolitan Mortality: 1959-1961, Public Health Service Publication AP-39, Cincinnati, Ohio, 1967.

KENTUCKY DEPARTMENT OF ENERGY

A Basis for Assessment and Planning

THE KENTUCKY SYNFUEL INDUSTRY
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KENTUCKY DEPARTMENT OF ENERGY

FOREWORD

The development of a synfuel industry in Kentucky is one of the most ambitious and far-reaching programs ever attempted by a state. The magnitude of that effort can best be understood by comparing the investment in the Apollo Space Program to the capital investment for the construction of four synfuel plants in west Kentucky. The Apollo Program cost $25 billion and put man on the moon, while the capital cost of the four synfuel plants, which will produce over 10% of the national synfuel target of two million barrels per day in 1992, is estimated to be $14 billion.

For us as a nation to overcome our dependence on imported oil, our energy development program must have the same national priority in the 1980s as the space program did in the 1960s. During that period the space program was supported by three administrations and both political parties. The goal of placing a man on the moon could not have been met unless that objective and the means of achieving it had remained constant during those administrations. The goal transcended partisan politics and was met. In order to achieve national energy self-sufficiency, that goal, and the strategy for achieving it, must likewise remain constant or we are destined as a nation to continued reliance on foreign sources of energy.

During the 1970s the basis for a synfuel industry was built through massive government and private industry efforts. We are nearing the point of construction of several projects–in fact the first project in Kentucky could begin as early as this fall. This report describes the synfuel industry planned for Kentucky, discusses its implications and lays the basis for detailed planning. This illustrates Kentucky's continued commitment to the goals that have been set. This document and those which will follow have the objective of assuring that everything possible is done at the state and local government level to see that the plants cannot only proceed on schedule, but be built and operated in an environmentally acceptable manner.

William B. Sturgill
Secretary
Department of Energy

THE KENTUCKY SYNFUEL INDUSTRY
A Basis for Assessment and Planning

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Division of Technology Assessment

KENTUCKY DEPARTMENT OF ENERGY

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PREFACE

This report was prepared in response to requests for information regarding the synfuel industry and is a basis for further planning by state and local government.

The Kentucky Department of Energy has been involved in the development of synfuels from coal since 1974. During that time the Department has worked closely with other agencies in state and local government and has attempted to keep the public informed through a variety of reports and publications. However, during the past year the character of that program has changed. Previously, the projects were primarily in the conceptual phase, but now the potential for a synfuel industry has become real. One project signed a construction contract while two others signed design contracts last year. The fourth project signed a design contract only last month. Thus, our assessment of the Kentucky synfuel industry and its cumulative impacts is occurring at the earliest feasible time.

At this time all the projects are funded for a design phase and much additional information is being generated. The information in this report is to be viewed as preliminary and will be updated as we have better and more complete data. The Kentucky Department of Energy will continue its coordinating role and disseminate such information and more detailed assessments as they are completed.

Ronald L. Sanders

Ronald L. Sanders
Commissioner
Bureau of Energy Research

EXECUTIVE SUMMARY

The purpose of this document is to provide detailed information regarding the development of a synthetic fuel industry and to serve as a basis for further assessment and planning. The national need for synthetics from coal to displace imported oil and the development of a synthetic fuel program in Kentucky to meet the need is discussed. The historical production of synfuels from coal is summarized and the technologies are described.

The four projects which make up the developing synfuels industry are described as follows: siting considerations, technologies used, participants, Kentucky involvement, and status. A range of quantitative parameters are presented including coal demand, labor, products, and others. These four proposed commercial synfuel projects are SRC-I, Tri-State, W.R. Grace, and Breckinridge H-Coal.

A summary of selected findings is given below:

- On the basis of its coal production, Kentucky is a major energy producing state. The State, however, produces little of its liquid fuel needs: 1978 production was 8% of consumption. The four proposed synfuel plants would produce more liquid fuels (77 MM barrels) than the state consumed in 1978 (72 MM barrels). The total output of the plants will be 260,000 barrels of oil equivalents per day.

- The electric utilities have plans to construct 10 new coal-fired units in the western Kentucky-southern Indiana region in the 1980 decade. This will add 6,600 MW of generating capacity and will require about 9 million tons of eastern Interior Basin Coal per year.

- The proposed synfuel project scheduling has all four commercial plants in operation by 1990. This must be viewed as the most optimistic schedule. Delays are likely for many reasons including difficulties with financing, environmental permitting, and labor.

- Synfuel plants will be the equivalent of multi-billion dollar chemical process plants with the capacity to consume (as a feedstock) more coal than the largest electric generating plants. However, on the basis of energy output, the synfuel plant cost, water consumption, air emissions, and land use are equal to or less than those for conventional energy technologies.

- A demand schedule of construction workers produced from a computerized model for each project and the overall synfuel industry shows a peak of 26,000 in 1986. The labor requirements for the construction of power plants in the region will be small compared to synfuel plant needs (2,000 in 1986).

- The craft distribution of the synfuel plant construction work force is similar to a combination of a power plant and chemical process plant; pipefitters make up 40% of the total synfuel plant construction force.

- The direct permanent jobs created by the synfuel industry will be evenly divided between the plant operating force and the coal mining force. About 8,000 jobs will be created in each of these sectors or a total of 16,000 direct jobs.

- Coal consumption of the synfuel plants will begin in 1985 at 6,000 tons per day and rapidly increase to 112,000 tons per day by 1990. The annual demand of the synthetic fuel plants for 37 million tons per year compares with production in the West Kentucky coal fields of 41 million tons in 1980 and of 54 million tons for the record year (1976).

- At the peak of construction, direct wages will be over $200 million per quarter and capital investment will be over $1 billion per quarter.

- Severance taxes on the coal required for the plants will be on the order of $43 million per year; income taxes from direct labor, $16 million; and other taxes, $14 million.

- The total value of the products from synfuel plants would be $9.1 million per day from coal valued at $2.8 million or an increase in the value of coal by a factor of 3.3.

- The capital investment in synfuel plants would be approximately $14 billion.

- Coal and product transportation will rely largely on existing transportation networks, principally rail and barge. Both systems have considerable excess capacity. Transportation problems could exist during plant construction due to the increased traffic volume on existing highways. Early planning will be essential in preventing severe strains on this system.

- The development of the synfuel industry in western Kentucky could bring significant benefits to local communities. In addition to new jobs, the development could result in addition of new and expanded public facilities, addition of new services and economic opportunities, and the creation of new cultural and recreational opportunities.

- The development could also lead to some social problems as a result of rapid or unplanned growth. Such problems include housing shortages and strains on existing facilities and services. But, due to the existing population base and infrastructure, the West Kentucky area has a much greater capacity to absorb new growth than other areas proposed for energy development.

- The largest population increase will occur during the construction period. A peak of 26,000 workers is projected for the mid-1980s (worst-case). By the end of the decade, a significant number of permanent jobs will be created by the synfuel industry (16,000 direct jobs in plant operation and mining). This should help prevent the boom-to-bust conditions that are sometimes experienced when a large workforce leaves an area at the end of the construction period.

- West Kentucky has adequate resources for the proposed synfuel development. The four plants would require 37 million tons of coal per year or 0.12% of the western Kentucky coal resource per year; 700,000 tons of limestone per year; and 30 billion gallons of water per year. The water needs will not be significant except during drought conditions. The two plants on the Ohio River could consume less than 1% of the low-flow, while the two plants on the Green River could use 16% of the low-flow.

- A significant body of environmental laws and regulations, both state and federal, exist to protect air and water quality. These rules will ensure that prior to construction the plants be able to demonstrate how pollution will be controlled to the allowable levels; that the plants are equipped with the most up-to-date pollution control equipment; and that plant emissions are monitored and reported to ensure compliance with permit conditions.

- Several areas in western Kentucky are currently experiencing problems with air pollution: particulate matter in Owensboro, Henderson, Muhlenberg County, and Vanderburgh County, Indiana, and ozone in Evansville, Indiana. Major contributors to the problems are indirect (nonindustrial) sources and mobile sources (automobiles). The Department of Natural Resources and Environmental Protection is responsible for bringing these areas into attainment in Kentucky by 1982. New sources, including synfuel plants, will not be allowed to contribute to these problems.

- Water quality problems in western Kentucky are due largely to mining activities and municipal wastes. New surface mining laws are designed to prevent acid drainage and sedimentation problems in the future. Synfuel plants, which are being designed for zero discharge, should have minor effects on water quality.

- The major land use concern about the synfuel industry is the possible loss of prime agricultural land due to plant siting, coal mining, and urban development. None of the proposed plants will use more than 1% of the farmland of any county. Surface mining regulations will require farmland to be restored to it original condition. Proper growth planning will be essential to prevent uncontrolled urban sprawl.

- Numerous planning efforts are underway at the state and local level to help prepare for the proposed synfuel development. Federal and state funds are available to assist in planning and to mitigate the impacts of energy-induced growth and development.

The Kentucky Department of Energy will continue to provide information regarding the synfuel projects, to coordinate the state's synfuel planning effort, and to provide assistance to Area Development Districts and local communities. The Department has several activities underway at this time, including further analysis of coal demand and supply, labor demand and supply, population increases, and regional air quality impacts.

ACKNOWLEDGEMENTS

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The final report production and graphic development were carried out by Jim Rogers.

A special acknowledgement is due David D. Drake, Deputy Secretary for the Kentucky Department of Energy, who expanded synfuel development efforts from a project focus to an industry perspective. Without his encouragement and support, this effort would not have been possible.

I. INTRODUCTION

An assessment of the synfuel industry developing in West Kentucky has begun in the Technology Assessment Division of the Kentucky Department of Energy. The assessment is ultimately to be a comprehensive evaluation of the synfuel industry and its ramifications for West Kentucky as well as the entire state. It does not have the scope or format of an environmental impact statement which will be written for each project. The primary objective is to develop a detailed description of the synfuel industry and identify impacts in order to stimulate and focus federal, state, and local planning. The information should also be useful in informing affected businesses and industries, the general public, and public interest groups about the synfuel industry.

This report, which completes the first phase of the effort, is a quantitative description of the industry and a preliminary assessment of the major impacts. This report will be the basis for the second phase of the assessment which will focus on specific issues regarding impacts of the industry. It should be emphasized that the implications of the industry that are detailed in this report are based on the assumption of the construction of four commercial synfuel plants in the 1980 decade. All the estimates herein are based on that assumption and should thus be viewed as tentative. The objective is to assist in solving problems that could interfere with or delay plant development, to bring programs into action to eliminate or ameliorate negative impacts on the community or region and to develop strategies for maximizing benefits to Kentucky from the synfuel industry. Those benefits include jobs, coal sales, tax revenues, secondary development, and economic growth.

Need for Coal and Derived Synfuels

The urgent need to produce synthetic fuels from domestic resources should be apparent from the $100 billion cost of imported oil in 1980 and shortages of oil and natural gas availability during the 1970s, and therefore will not be reiterated here. National policy has recognized that need as evidenced by the ambitious production targets of 500,000 barrels per day of synthetic fuels by 1987 and 2 million barrels per day by 1992. The overall national target has been to eliminate 4.5 of the total 8 million barrels of imported oil per day. As Table 1 illustrates synthetic fuels are not the only element in that program as set forth by the Energy Security Act. The conversion of power plants using oil to coal, conservation and other programs are projected to reduce imports by some 2.5 million barrels per day. Recently enacted energy legislation, the creation of the Synthetic Fuels Corporation and the appropriation of $20 billion to support synthetic fuel production indicate a national commitment to the creation of a synthetic fuels industry. Coal must play a major role in synthetic fuels and U.S. Department of Energy estimates have placed its contribution in total production in the 70 percent range. The national coal resource is adequate to support such production. Coal makes up more than 90 percent of the total domestic resource yet in recent years has supplied less than 20 percent of energy usage.

Table 1
National Oil Import Reduction Targets*

Utilities — Convert from Oil		750,000 B/D
Heavy Crude Oil		500,000 B/D
Conservation		500,000 B/D
Mass Transit, Better Auto Efficiency		250,000 B/D
"Unconventional" Natural Gas		500,000-1,000,000 B/D
	Sub-Total	2,500,000-3,000,000 B/D
Synfuels from Coal Shale Oil Methanol, Ethanol		2,000,000-1,500,000 B/D
	Total	4,500,000 B/D

* As proposed by the Carter Administration for 1992.

Kentucky Synfuel Program

The synfuel industry in Kentucky has not developed out of happenstance, but from state policies, programs, and a major financial commitment over the last decade aimed at the development of such an industry. The objectives for the development of a coal-based synthetic fuels industry have been and remain to

- create new and stable markets for high sulfur coal
- stimulate economic development
- achieve a higher added value from the coal resource.

Kentucky's policy regarding synthetic fuel development was stated in the 1974 Energy Development and Demonstration Act as follows:

"It shall be the policy of the Commonwealth of Kentucky to encourage and promote the development and demonstration of efficient, environmentally acceptable and commercially feasible technologies, techniques, and processes for conversion of coal into clean fuels in liquid, gaseous, or solid forms."

The Commonwealth made a commitment to the development of synthetic fuels in 1972 with the appropriation of coal research funds by the General Assembly. This was substantially increased by the 1974 legislature which created a $50 million trust fund for promoting coal conversion. Funding was also authorized for a vastly increased coal R & D Program and a specialized coal research laboratory to support the demonstration effort. The commitment to the development of synthetic fuels from coal in Kentucky has been restated by the actions of five successive state legislatures and by the leadership provided under three successive Administrations. The original trust fund has been increased to $55 million and an additional $30 million in bonding capacity has been authorized bringing the total potential commitment to over $100 million. Trust fund commitments to date are $47.6 million.

As a result of the state's activities, the coal resources, and the availability of river sites, previously identified by the Department of Commerce, Kentucky was in a position to proceed with synfuel plant developments already well along in the planning when the national intent to develop alternate fuels from coal became apparent in late 1979 and 1980.

Synfuel Background

The term synthetic fuel when applied to coal means the production of clean fuels which can be substituted for "natural" fuels such as natural gas or liquid fuel from petroleum. More commonly synthetic fuel has come to mean the chemical alteration of coal such that its major contaminates (ash and sulfur) are removed and the resultant fuel is in a physical form suitable for convenient use in homes, industry, power generation, or transportation. Coal is a complex, widely varied mineral containing a large percentage of carbon from which most of its energy value is derived. In addition it contains nearly every known element and complex chemical compounds. The coal must be subjected to extreme conditions of temperature and pressure for chemical bonds to be broken in order to produce the more simple hydrocarbon compounds that are typical in liquid and gaseous fuels. Coal is generally deficient in hydrogen compared to the fuels that are desired so additional hydrogen must also be added for some types of fuels. The two major methods for producing synthetic fuels as shown in Figure 1 are gasification and liquefaction.

In the gasification process the coal is partially oxidized in a deficiency of air and broken down into very simple gases; hydrogen, carbon monoxide, and methane. Those gases are combustible and may be used directly as a fuel gas or as a chemical feedstock. To produce a gas suitable for distribution in existing pipelines the gases must be further chemically processed to produce nearly pure methane, the major component of natural gas. Liquid fuels may also be produced from coal derived gas as shown in Figure 2. The combination of carbon monoxide and hydrogen is referred to as synthesis gas when they are processed chemically to produce other products such as ammonia, methanol, or other hydrocarbons.

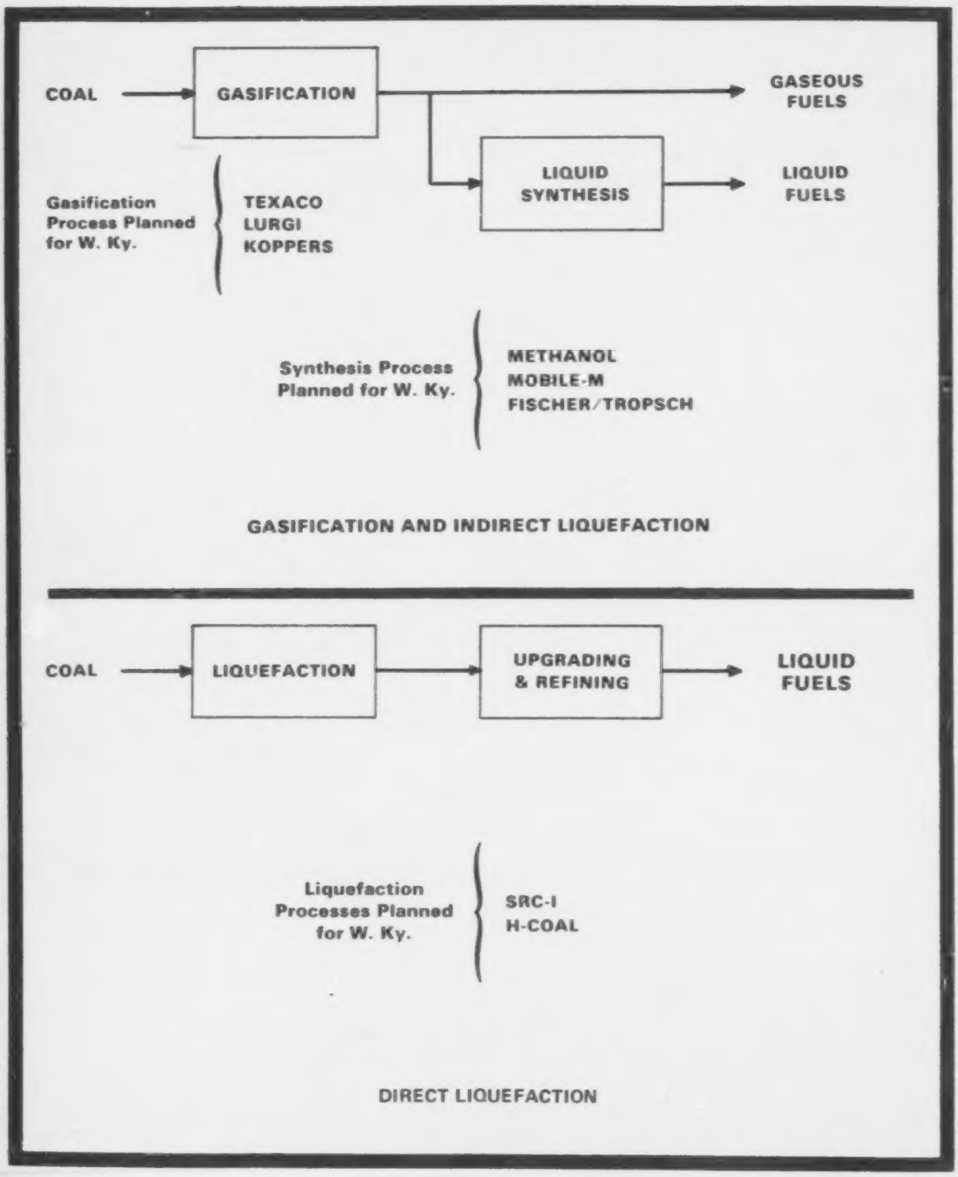
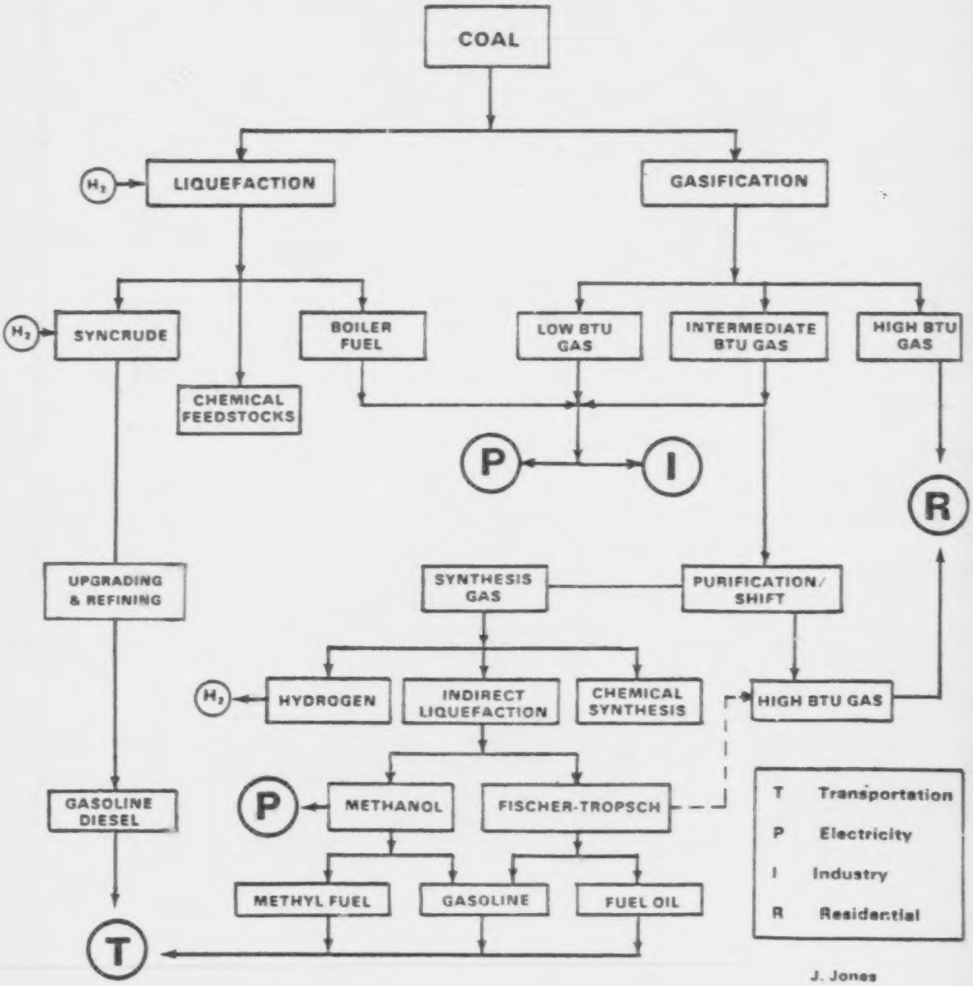

COAL
GASIFICATION
GASEOUS FUELS
LIQUID SYNTHESIS
LIQUID FUELS
Gasification Process Planned for W. Ky.
TEXACO
LURGI
KOPPERS
Synthesis Process Planned for W. Ky.
METHANOL
MOBILE-M
FISCHER/TROPSCH
GASIFICATION AND INDIRECT LIQUEFACTION
COAL
LIQUEFACTION
UPGRADING & REFINING
LIQUID FUELS
Liquefaction Processes Planned for W. Ky.
SRC-I
H-COAL
DIRECT LIQUEFACTION

Figure 1. Simplified Block Diagrams for Gasification, Indirect Liquefaction and Direct Liquefaction

Figure 2. Coal Conversion Routes, Products, and Markets


COAL
H₂
LIQUEFACTION
GASIFICATION
H₂
SYNCRUDE
BOILER FUEL
LOW BTU GAS
INTERMEDIATE BTU GAS
HIGH BTU GAS
CHEMICAL FEEDSTOCKS
P
I
R
UPGRADING & REFINING
SYNTHESIS GAS
PURIFICATION/ SHIFT
H₂
HYDROGEN
INDIRECT LIQUEFACTION
CHEMICAL SYNTHESIS
HIGH BTU GAS
GASOLINE DIESEL
P
METHANOL
FISCHER-TROPSCH
METHYL FUEL
GASOLINE
FUEL OIL
T
T Transportation
P Electricity
I Industry
R Residential

J. Jones
KDOE

The second generic type of coal conversion, liquefaction, involves only a partial breakdown in the chemical structure of coal and usually the addition of hydrogen. The three major types of liquefaction processes are hydrogenation, solvent refining, and pyrolysis. Hydrogenation technologies involve the breakdown of the coal molecule by temperature, pressure, and hydrogen often in the presence of a catalyst. Solvent refining techniques are similar but use a solvent which dissolves the coal and promotes the transfer of hydrogen. Pyrolysis processes are similar to coke oven processes and usually operate at lower temperatures and remove only a portion of the hydrocarbons as light liquids (e.g., benzene), gases and tars. The bulk of the carbon after processing remains in the char, which must be used in some manner (e.g., as a boiler fuel) for the process to be viable. The products from liquefaction fall generally into two types. The first is a heavy, high boiling temperature hydrocarbon which could be used as a boiler fuel. The second type of product is a synthetic crude oil which could be further refined to lighter hydrocarbon transportation fuels. Lighter hydrocarbon liquids and gases are also produced directly in lesser quantities and may be used with minimal additional upgrading as fuels or as chemical feedstocks.

The production of synthetic fuels from coal is not a recent development and a variety of processes have been used in large scale production on many types of coals around the world. The gasification process was discovered in the late 1700s and hydrogenation and Fischer-Tropsch synthesis developed in Germany in the early 1900s. Gas was first produced from coal in Kentucky in the early 1800s and since that time both gaseous and liquid fuels as well as chemicals have been produced commercially in the state at several locations. Methanol synthesis from coal derived gases was developed in the 1920s. The production of "towngas" from coal was common in Europe and the United States for residential and street lighting during most of the nineteenth century. The application of gasifiers that are the predecessors of modern units was widespread during the 1920s and 1930s. In 1936 the Federal Trade Commission reported that 4,800 producer-type gasifiers were installed in the United States. The gas produced varied from a fuel gas to a synthesis gas. Most of the world's production of ammonia and methanol, as well as many other chemicals, came from coal at one point. Liquefaction applications from both direct and indirect methods were also widespread through World War II, particularly in Germany. The German production of oil from coal and coal tar was reported to be over 5,000,000 tons/year.

There was a resurgence of interest in synthetic fuels from coal after World War II with the acquisition of the German plants and technical information. A number of research and small commercial projects were begun. A detailed study by the U.S. Corps of Engineers in 1951 on the Synthetic Liquid Fuel Potential of Kentucky identified the potential for over 30 synfuel plants of the 50,000 barrel per day size in West Kentucky. The availability of Middle East oil at $1.25 per barrel and a national pipeline system to distribute natural gas which cost under $0.20 per million Btu, caused all of these efforts to be put on the shelf. By the mid-1950s nearly all synfuel projects in the U.S. had been terminated. Activity in synthetic fuels research re-emerged in the 1960s and was aimed at the development of a new generation of more efficient technologies which could be viable in the present day economic and environmental situation. The Arab oil embargo of 1973 and the natural gas shortages of the 1970s caused interest in synthetic fuels to heighten and pressure to mount for their development at a more rapid pace. Having already begun coal research programs in 1972, Kentucky was therefore in a position to respond in 1974 with a major synthetic fuels development program.

II. PROPOSED ENERGY FACILITY DEVELOPMENTS

The synthetic fuels from coal industry in Kentucky as discussed in this report includes four coal conversion plants which are in various stages of development in West Kentucky (see Figure 3). There are other synthetic fuel plants in Central and East Kentucky, but these are pilot rather than production plants or are smaller plants dedicated to one industry or development. Potential projects which are not active under a current contract were also excluded from the assessment. Electric power plant construction or expansion projects planned in the same region as the synfuel plants have been included in the assessment. The construction of a total of 10 new coal-fired electric generating units is planned for six plants (see Figure 3) in the region in the 1980s.

Siting Factors

The West Kentucky area has emerged as one of the most attractive locations for synthetic fuel plants primarily due to available coal resources close to major rivers. Because of the greater expense in transporting coal compared to the expense of transporting synthetic fuels, which have a higher energy density and are more easily transported, most synthetic fuel plants will either be mine mouth or in close proximity to the coal source. The national coal resource map (Figure 4) indicates where synthetic fuel plants might be built. Although the far western part of the U.S. has huge coal deposits, synfuel plants previously planned for that region have had difficulties with water availability, local infrastructure, federal land acquisition, transportation networks, and distances to market. The generally rough terrain of the Appalachian region makes the siting of large projects difficult and the lower sulfur steam coal and metallurgical coals which make up a large portion of the reserve command premium prices. Midwest coals are more uniquely suited for a synthetic fuel feedstock than low sulfur coals since the use of high sulfur coals in steam plants is restricted. The cost of sulfur removal in synfuel plants is accomplished more readily and is not as sensitive to level of sulfur content of the feed coal. The reason that sulfur is technically more easily removed in a synfuel plant is that it is converted in the process primarily to hydrogen sulfide, which is more amenable to removal by scrubbing techniques than the sulfur dioxide produced by power plants. The hydrogen sulfide is also much more concentrated in the gas stream and can be removed more economically thereby allowing removal efficiencies in excess of 99% while sulfur dioxide systems are limited at the present to about 90% removal. An additional advantage of the use of high sulfur coals in synthetic fuel plants is that sulfur is recovered as solid elemental sulfur, which is used in the production of sulfuric acid, the largest volume chemical in the U.S. On the other hand, sulfur recovered in power plant scrubbers is in the form of sludge which is a costly and land consuming disposal problem. Midwestern coals have also been demonstrated to be more reactive than other coals in direct liquefaction processing and are therefore a preferable feedstock. The Midwest has been identified as the most favorable location for synfuel plants, particularly the first round of those plants. A recent study by the Pace Engineering Company identified the potential for 10 synthetic fuel plants for West Kentucky. The 1992 national goal for this production of alternative fuels

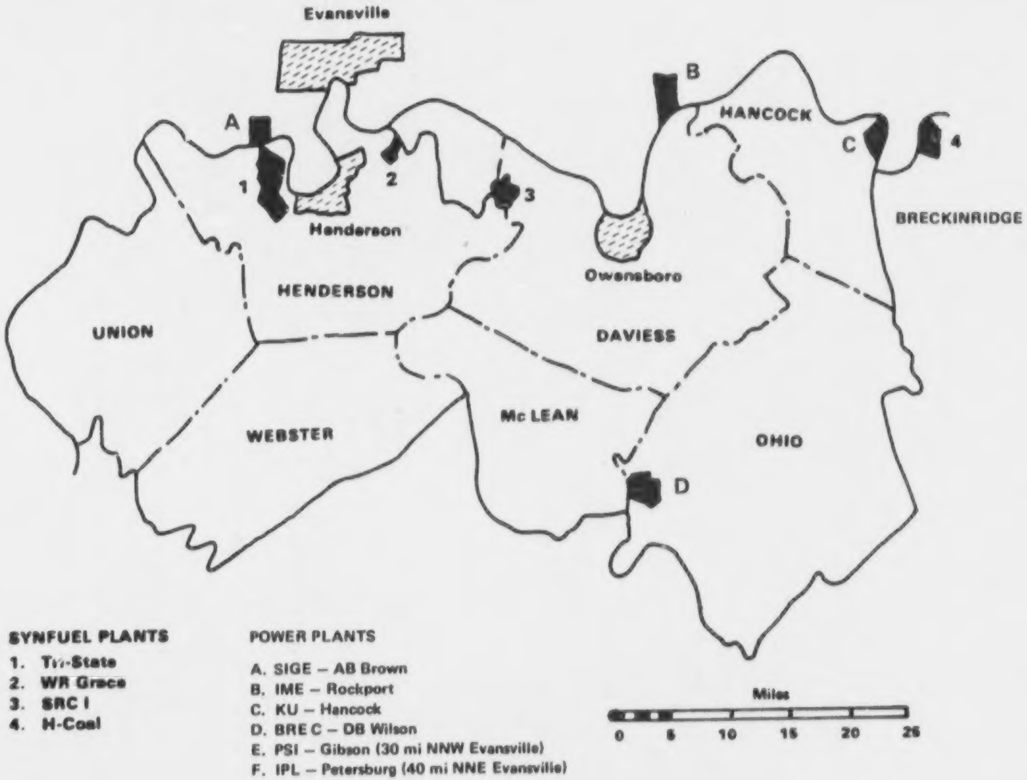

Evansville
A
B
HANCOCK
C
4
1
2
3
Henderson
BRECKINRIDGE
Owensboro
HENDERSON
UNION
DAVIESS
Mc LEAN
WEBSTER
OHIO
D
SYNFUEL PLANTS
1. Tri-State
2. WR Grace
3. SRC I
4. H-Coal
POWER PLANTS
A. SIGE – AB Brown
B. IME – Rockport
C. KU – Hancock
D. BREC – DB Wilson
E. PSI – Gibson (30 mi NNW Evansville)
F. IPL – Petersburg (40 mi NNE Evansville)
Miles
0
5
10
15
20
25

Figure 3. Energy Facilities Planned for the Western Kentucky Region

would require some 30 coal conversion plants, many of which will be located in the far western U.S. The location of 71 proposed coal conversion projects is shown in Figure 5.

The sites for each of the four projects in Kentucky have been selected by their respective industrial developers after screening a number of potential sites in Kentucky and in a number of other states. Factors, in addition to the coal and rivers, that have attracted the plants to Kentucky are the availability of large river-front sites, rail, highway and barge transportation networks (see Figure 6), an available labor pool, developed local infrastructure, and a favorable political climate. The primary output of all of the plants is a liquid fuel or a substitute for petroleum fuels. The current national synfuels development policies place the highest priority on the production of liquid fuels, especially transportation fuels because of the enormous oil imports and their disruption in recent years. The development of plants dedicated to the production of substitute pipeline gas appears to be receiving less emphasis due to the availability of natural gas at this time. However, it is likely that natural gas availability will decline and that gasification plants will be re-emphasized and become a part of the active synthetic fuels industry in Kentucky.

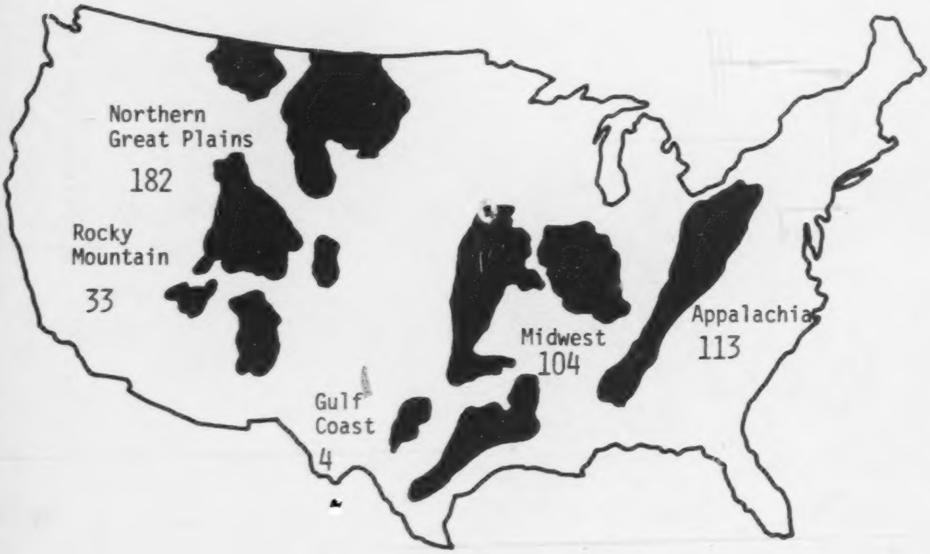


Figure 4. U.S. Coal Reserves (billions of tons)

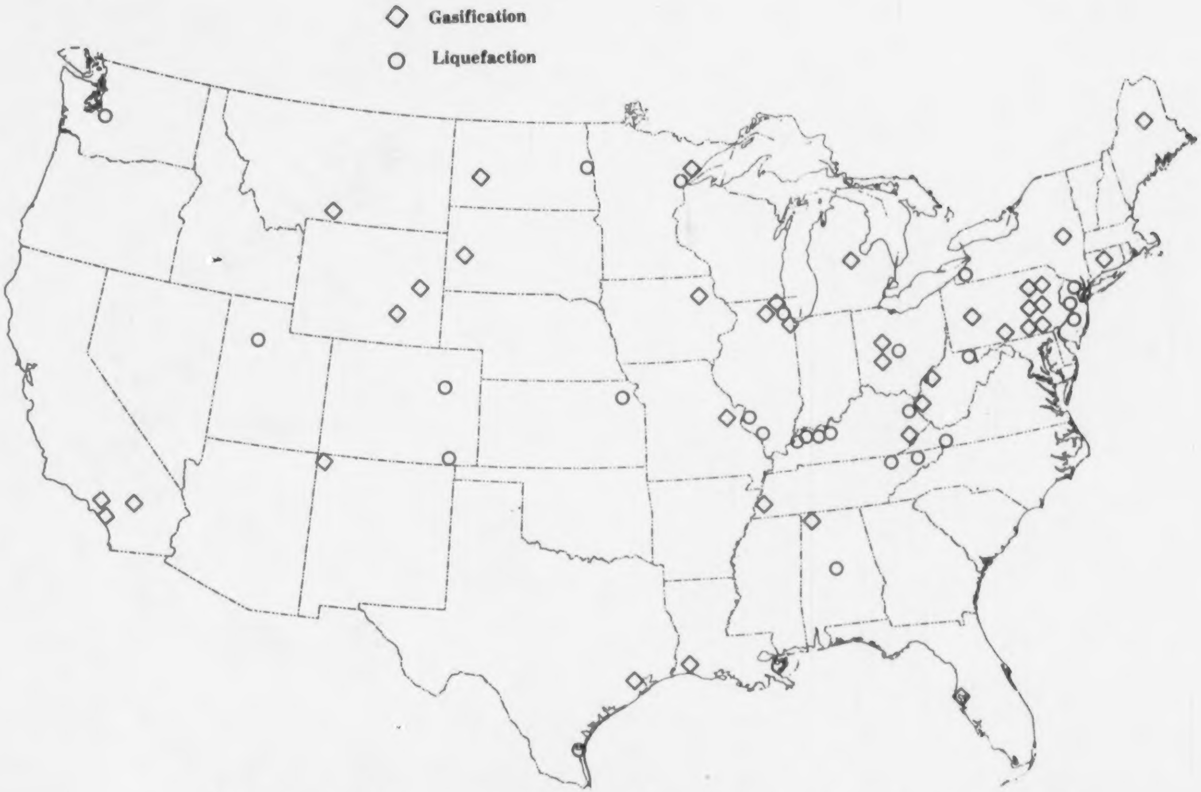

◇ Gasification
○ Liquefaction

Figure 5. Location of Operating, Under Construction, or Proposed Synfuels Plants

Source: Compiled from *Coal Synfuel Facility Survey*, National Coal Association Survey, August 1980.

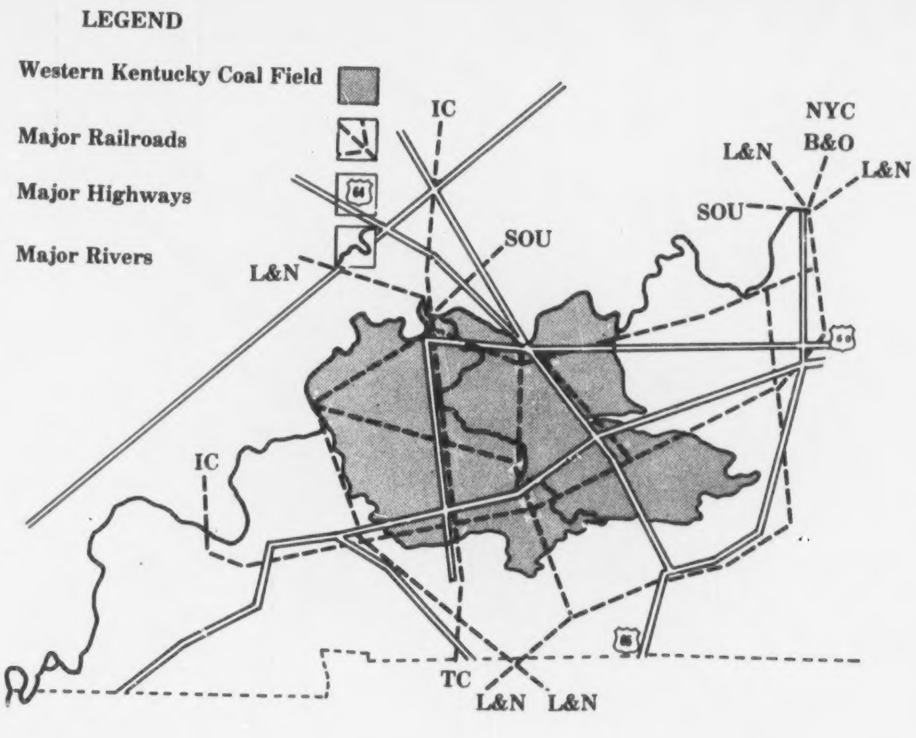

LEGEND
Western Kentucky Coal Field
Major Railroads
Major Highways
Major Rivers
IC
NYC
L&N
B&O
L&N
SOU
SOU
L&N
IC
TC
L&N
L&N

Figure 6a. Transportation Schematic for Western Kentucky Coal Field (major railroads, highways and rivers)

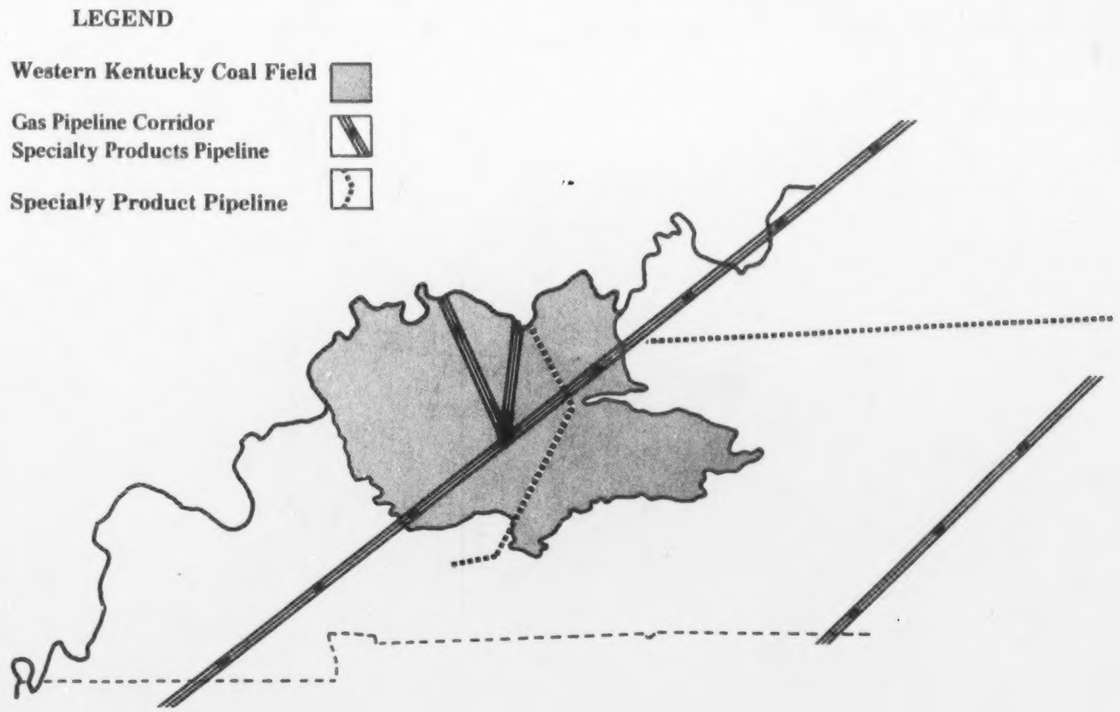

LEGEND
Western Kentucky Coal Field
Gas Pipeline Corridor
Specialty Products Pipeline
Specialty Product Pipeline

Table 6b. Transportation Schematic for Western Kentucky Coal Field (gas pipeline and specialty products)

Synfuel Project Descriptions

Of the four West Kentucky plants that will produce liquid fuels from coal, the process technologies are split evenly with two direct and two indirect liquefaction plants. The SRC-I and the H-Coal plants use direct processes while the W.R. Grace and Tri-State plants use the "indirect" approach (described previously). The fuel outputs of the plants vary from those suitable for direct sale and use to those which must be further processed, perhaps at an existing off-site refinery, or blended with other fuels. The quantitative description of each of the plants in Table 2 includes the coal requirements, capital investment, product slate, employment and other data.

SRC-I - The Solvent Refined Coal (SRC) plant employs a direct liquefaction process to produce three primary products; a clean, solid boiler fuel, a liquid fuel, and coke. The project is being developed by the International Coal Refinery Company (ICRC) which is a joint venture of the Wheelabrator-Frye Company and Air Products and Chemicals, Inc. The plant differs from the remaining three synfuel projects in that its development is being staged with a demonstration plant of 6,000 TPD coal capacity which will be expanded, upon successful operation, to 30,000 TPD. The project is also unique in that the U.S. DOE is providing 90% of the demonstration plant cost under the Fossil Energy Division demonstration program. The contract between the U.S. DOE and ICRC signed in August, 1980 will take the project through final design, construction and an operational period of at least two years. Stone and Webster is being considered for the project construction manager. The commercial SRC-I plant (as well as the other synfuel plants) will in all likelihood seek Federal support from the Synthetic Fuel Corporation. Kentucky's involvement with the project began with the acquisition of site options and funding of a design for a small 2,000 TPD plant in 1976. That design was scaled up to 6,000 TPD at the suggestion of the U.S. DOE and others so that the demonstration plant would be of sufficient size to be the first module of a commercial plant. The Kentucky Department of Energy has a purchase contract on the site near Newman, Kentucky and is authorized to issue up to $30 million in bonds to support the construction of the plant. The Kentucky funding will be used for environmental control equipment.

The SRC process technology has been under development since 1964. The technology has been developed on the pilot scale at two facilities which continue in operation. A 5 ton per day unit is located at Wilsonville, Alabama, and a 50 ton per day unit is located at Ft. Lewis, Washington. Both plants have processed Kentucky coals and have provided design data and samples for product and environmental testing. An extensive data base for the SRC process exists and is largely available from U.S. DOE reports. The SRC process involves dissolving coal in a process-derived oil which also promotes the transfer of hydrogen to the coal. That processing is carried out at 825°F and a pressure of 1700 psi. The remainder of the processing involves separation of the liquid and gaseous production from each other and into various product streams using conventional technology. The most difficult remaining process step is the separation of the mineral matter (ash) from the dissolved coal liquid.

Table 2
Kentucky Synfuel Plant Parameters

Project	Location	Sponsor	Coal Consumption (TPD)	Products	Peak Construction Labor	Permanent Operating Force	Electrical Requirements (MW)	Capital Investment ($ billion)
SRC-I Demonstration	Newman	ICRC	6,000	20,000 barrels/day oil equivalent, solid boiler fuel, liquid boiler fuel, anode coke, naphtha, gases	3,500	725	101	1.5
Tri-State	Geneva	Texas Eastern, Texas Gas Transmission	30,668	50,000 barrels/day oil equivalent, liquid transportation fuels, pipeline quality gas, chemicals	15,000	3,000	100	4
Breckinridge H-Coal	Addison	Ashland Synthetic Fuel, Airco Energy Corp.	22,500	50,000 barrels/day oil equivalent, synthetic refinery feedstocks and fuel oils	5,000	1,500	300	2.4
W.R. Grace	Baskett	W.R. Grace Co.	28,800	50,000 barrels/day unleaded gasoline, 3,500 barrels/day LPG, 5,000 barrels/day butanes	6,000	1,350	77	3
SRC-I Commercial	Newman	ICRC	24,000*	80,000 barrels/day oil equivalent*	6,000	1,475*	375*	3*

* In addition to the SRC-I Demonstration.

There are two variations on the SRC process which are being developed. The SRC-I process was originally aimed at producing a uniform, low ash, low sulfur solid boiler fuel with a high heating value (16,000 Btu per pound). The design basis for the SRC-I demonstration plant has been made more flexible so that it will also produce a liquid stream which can be processed into transportation fuels as well as boiler fuels. A premium grade anode coke, in demand by the aluminum and other industries, will also be produced. The other process variation, SRC-II, is planned for demonstration at a West Virginia site. That process differs in that only a liquid boiler fuel will be produced.

W.R. Grace - This project uses an indirect liquefaction process to produce gasoline from coal. The W.R. Grace Company began the project in 1976 as a smaller coal to ammonia project. At the end of a two year study which produced a design, technical and site specific environmental data, the scope and size of the project were changed. Because of the lag in demand for ammonia and the need for liquid fuels the project was modified to produce gasoline. The site for the project, which is near Baskett, was optioned by the Kentucky DOE in January, 1976 and purchased in 1980.

The Grace project will use gasification technology developed by Texaco to produce a synthesis gas (a mixture of hydrogen and carbon monoxide) which will be converted by conventional technology to methanol. The methanol will in turn be fed to the Mobil MTG process which converts methanol to high octane gasoline. Butane and propane (natural gas liquids) are also produced in significant quantities. The Texaco gasification technology was developed in the late 1940s for gasifying residual oil and gas and units have been built for that application in 75 plants located in 20 countries (including 7 units at the W.R. Grace Memphis facility). Pilot units ranging from 15 to 20 TPD of coal have been operated at Texaco's Montebello research facility in California. West Kentucky coals were extensively tested in support of the Grace project. According to EPA criteria, this slag is a non-hazardous material. Texaco gasifiers have been operating on coal in West Germany since 1978 at a 150 ton per day facility. A 50 ton per day Texaco gasifier was started up in October, 1980 by TVA at their fertilizer production facility and Kentucky coals will be extensively tested there. The Mobil MTG process has been tested at Mobil's New Jersey Research Laboratory. Mobil has 21 catalytic units similar to that used in the MGT process commercially processing petroleum and petrochemical feedstocks.

A contract to carry out a preliminary design for the Grace project was signed with U.S. DOE in November, 1980. The design contractor is the Ralph M. Parsons Company and the effort will take 24 months and will place the project at the point of securing financing and entering into final design and construction.

Tri-State - The Tri-State project will utilize the indirect liquefaction technology which is the basis for the only commercial plant in the world producing liquid fuels from coal. The project being developed by the Texas Eastern Corporation (managing partner) and the Texas Gas Transmission Company of Owensboro. The primary fuel outputs are gasoline and a pipeline quality gas. A wide range of chemical feedstocks are also produced, including ethylene and alcohols. Because the Tri-State project is much more complex than the other synfuel projects in terms of the number and types of products produced, the project will cost more and require greater numbers of construction and operating workers. After a Kentucky site was selected at Geneva, west of Henderson, in early 1980, the KDOE committed to acquiring site options and assisting with the test of Kentucky coals at the full-scale SASOL plant in South Africa.

The Tri-State project will employ the Lurgi gasification technology to produce a gas which will be fed into a Fischer-Tropsch synthesis unit which produces gasoline, gas, and chemicals. Those technologies are in operation at the SASOL plant which has been in production for twenty-five years. The plant being designed for Kentucky will closely resemble the SASOL II plant which has recently started production. That plant was designed and built by the Fluor Engineering Company which will also design the Tri-State plant. The Tri-State facility will differ from SASOL II as necessitated by the difference in feedstock coals, the more stringent U.S. environmental requirements, and the product slate distribution most feasible for the U.S. market. SASOL has already begun construction of SASOL III, a duplication of SASOL II which will give South Africa a total capacity of synthetics from coal of 112,000 barrels of oil per day or about half of that nation's requirements.

Midwestern coals similar to West Kentucky coal have been successfully tested previously in Lurgi gasifiers. The tests were in a small size unit and of a limited duration; therefore, full scale tests at SASOL of West Kentucky coals are planned. Those tests will require approximately 22,000 tons of coal and will provide the information necessary for the design. The Tri-State project was recently awarded a $24.3 million dollar co-operative agreement from the U.S. DOE. Work under that agreement will include a detailed design, environmental assessment and economic analysis. At the completion of that phase of the work, which will take two years, the project will be at the point of securing financing and beginning construction.

Breckinridge H-Coal - The commercial H-Coal plant is being developed as a joint venture of the Ashland Oil Company and Airco Energy Co. The plant will use a direct liquefaction technology and will produce liquid transportation fuels and boiler fuels from 22,500 TPD of coal.

Kentucky has been a participant in the development of the H-Coal process since 1974. This work led to the construction of a 600 TPD pilot plant at Catlettsburg, Kentucky which started up in mid-1980. That project was 80% funded by the U.S. DOE with the balance split between a consortium made up of the Commonwealth of Kentucky, Ashland Oil, The Electric Power Research Institute, Mobil Oil, Conoco, and Ruhrkohle. Kentucky has committed $6.4 million to the project and agreed to provide up to 88,000 tons of coal for testing.

Development of the H-Coal process began in 1964 as a spin-off of the related H-Oil process for upgrading heavy oils. A 3 ton per day pilot plant in Trenton, New Jersey has been in operation since the late 1960s. The process involves reacting coal with hydrogen in the presence of a catalyst at a temperature of 850 degrees Farenheit and a pressure of 3,000 psi. The coal molecule is broken down into smaller liquid and gaseous hydrocarbons. Kentucky coals have been processed and an extensive data base exists. The pilot plant which is the largest coal liquefaction plant in the U.S. began operations on coal in May, 1980. The program calls for tests of both Western and Eastern U.S. coals including West Kentucky coal. The process and environmental data will be used in the design of the commercial plant.

Ashland Oil and Airco received a $7.5 million dollar contract for the conceptual design of the commercial H-Coal plant with engineering being done by the Bechtel Company. The Commonwealth has spent $250,000 for additional coal testing in support of the commercial plant design and has acquired options for the site selected by Ashland Oil in Breckinridge County. At the completion of that preliminary phase in early 1982 the project will be at the point of conducting the final plant design. Following that, the project must secure financing and can then begin construction.

Power Plant Construction and Expansion

A number of electric utilities have plans for new plants and expansions in the western Kentucky area. All of the proposed additions are conventional coal-fired units. These plants will add a total of 6,600 MW to the generating capacity for Indiana and Kentucky and will consume about 9 million tons per year of eastern Interior Basin Coal. A list of existing and planned facilities is shown in Table 3.

Rockport (Indiana & Michigan Electric) - This plant consists of two 1300 MW units and is presently under construction near Rockport, Indiana on the Ohio River. I&ME, a subsidiary of American Electric Power, serves northern and eastern Indiana. The plant is located on 3,820 acres and will have a single 1,040-foot stack. The utility elected to comply with the sulfur emission requirements by purchasing low-sulfur coal from the western U.S. (about 30,000 tons/day) rather than install flue gas desulfurization (FGD).

Gibson (Public Service of Indiana) - The Gibson station on the Wabash River near New Harmony, Indiana currently consists of 4 units totaling 2,636 MW of generating capacity. Unit No. 5 is now under construction and will add another 650 MW. PSI serves a broad area over central Indiana.

A.B. Brown (Southern Indiana Gas and Electric Company) - SIGECO has a single 250 MW unit located between Evansville and Mt. Vernon, Indiana on the Ohio River. Planned expansion at this site includes units No. 2 (250 MW) and No. 3 (500 MW). All three units will use FGD and high-sulfur coal from Indiana, Illinois or Kentucky. SIGECO serves southern Indiana.

D.B. Wilson (Big Rivers Electric Corporation) - This is a new station planned for Ohio County, near Livermore, Kentucky on the Green River. Construction on the first 2 units (440 MW each - 395 MW net) began in 1980. The site consists of 2,317 acres (much of it strip mined land) and could accomodate additional units. The plant will use FGD and western Kentucky coal. Big Rivers serves the western Kentucky area.

Table 3. Coal-Fired Steam Plants in the Western Kentucky Area

Utility — Plant	Generating Capacity (MW)	Status
Southern Indiana Gas & Electric		
A.B. Brown	250	Existing
A.B. Brown	250	1985
A.B. Brown	500	1987
Warrick-Alcoa	731	Existing
Culley	414	Existing
Indiana & Michigan Electric		
Rockport	1,300	1983
Rockport	1,300	1985
Kentucky Utilities		
Hancock County	650	1988
Hancock County	650	1991
Green River	263	Existing
Big Rivers Electric Coop.		
Coleman	521	Existing
Reid/Green	930	Existing
Wilson	395	1984
Wilson	395	1986
Owensboro Municipal Utilities		
Smith	416	Existing
Henderson Municipal Light & Power		
Henderson	40	Existing
Tennessee Valley Authority		
Paradise	2,558	Existing
Public Service Co.		
Gibson	2,600	Existing
Gibson	650	1982
Indianapolis Power & Light		
Petersburg	1,338	Existing
Petersburg	515	1984

Hancock County (Kentucky Utilities) - KU serves parts of eastern, central, and western Kentucky. The proposed new station would be located on 3,500 acres at Skillman, Hancock County (near Hawesville) on the Ohio River. Two 650 MW units are planned. Both would use FGD and high-sulfur coal.

Petersburg (Indianapolis Power & Light) - Petersburg is an existing station on the White River in Pike County, Indiana about 50 miles north of Henderson. The site now consists of three coal-fired units with a total capacity of 1338 MW. Unit No. 4 is also coal-fired and will add 515 MW to the station upon its completion in 1984.

Scheduling of Projects

The most recent schedule (December, 1980) for the construction of the proposed synthetic fuel plants in western Kentucky is shown in Figure 7. Also shown in the figure are the power plants that are proposed for the same period. Power plants are the largest current construction projects in the region. Synfuel plants will require considerably larger workforces than power plants (see Chapter IV). Thus, these two industries together would dominate the construction effort for the next 10 years or so in West Kentucky. Activity could peak around the middle of the decade if all of the projects stayed on schedule (9 of the planned facilities could be in construction during 1984).

These schedules are critical for the planning activities which need to take place now in order to prepare for an orderly industrial development. Thus, it is important to understand some of the uncertainties associated with these schedules. The largest uncertainty exists concerning the synfuel projects. These are all first of a kind plants which are now in the engineering design stage. After the design is completed a decision will be made whether or not to continue the project based on the process feasibility, economics and many other factors.

Another critical step is the financing of the projects. Due to the large capital costs no single corporation can stand to accept all of the risk exposure alone. None of the projects have yet secured the necessary financial commitments to begin commercial construction. The SRC-I project has the financial commitment to carry it through the construction of the demonstration plant (one-fifth commercial size), but even this project has a number of decision points (whether to proceed or not to proceed) before construction commences. The U.S. Synthetic Fuels Corporation, which began activities in 1981, will provide financing mechanisms for the most promising synthetic fuel projects in the form of loan guarantees, purchase agreements, price supports, and price guarantees.

The environmental permitting process could lead to delay, alteration, relocation or abandonment of one or more of the projects. Since all the projects will constitute major actions by the federal government, each will require an Environmental Impact Statement (EIS), which is an assessment of the effect that plant construction and operation will have on human health and welfare, aquatic and terrestial ecology, environmental quality, archaeo-

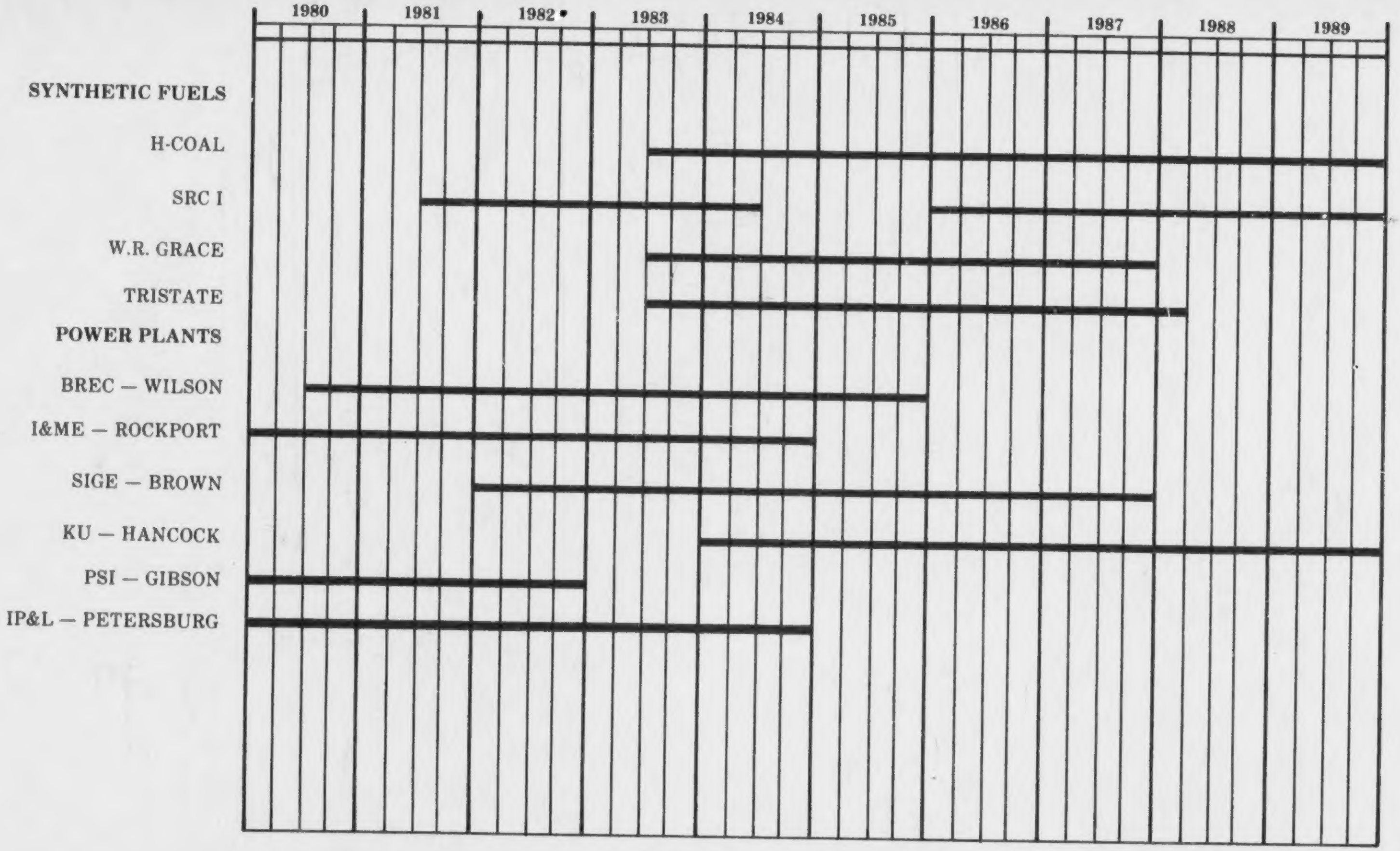


Figure 7. Western Kentucky Energy Project Construction Schedule

Source: Kentucky Department of Energy, Bureau of Energy Research, January 1981.

logical and historic sites, wetlands and floodplains, and so on. This process involves collection of background and project data, writing a draft statement. a public hearing and comment process, followed by issuance of a final EIS and a finding by the agency whether or not to continue the action. The process takes a minimum of 1-2 years and, of course, there are possibilities for project delays due to negative findings and litigation.

A number of other major environmental permits must be obtained from various state and federal agencies (Table 4). Most of them take 6 to 12 months to process, but delays of 2 to 3 years are possible. In some cases, the permits are needed to start construction and will, thus, be on the critical time path. In addition to these permits, numerous federal (Table 5), state, and local laws will affect facility siting, construction, and operation.

Another area of uncertainty is a result of the present state of technology development. Although all the conversion processes proposed for western Kentucky are technically feasible, the plants will be, in one sense or another, first-of-a-kind. This means that the schedule for the final engineering design phase is difficult to estimate at this point, since some of the processes are only now in the conceptual or preliminary design phase.

In addition to delay of the construction start, it is possible that the construction period could be lengthened. Of prime concern here are the delivery of major process equipment and the availability of labor, and any other labor problems. Such problems are a concern even for relatively isolated construction projects and could be much more significant in western Kentucky due to the high concentration of activity. As an example, the 600 ton per day H-Coal pilot plant at Catlettsburg, planned for an 18 month construction period, took 36 months to build. The scheduling shown in Figure 7 represents the most optimistic expectations for all the projects. Some deviations from this schedule are likely for each one of them. This applies for the power plants as well – some of their schedules have already slipped by 3 to 4 years.

Effect of Synfuels Industry on Kentucky's Energy Production

Kentucky has traditionally been an energy producing state. It is, in fact, the third largest producer, behind only Texas and Louisiana. Kentucky accounts for about 6% of the nation's energy production with less than 2% of the nation's population. The state also ranks high in net energy exports, or total energy production less consumption. Only 11 states produce more energy than they consume. Kentucky has been able to do this on the basis of coal production. Consistently the nation's leader, Kentucky's production of 156 million tons of coal in 1980 was 19% of the U.S. total.

The bulk of the state's energy production (97%) and all of the net exports are accounted for by coal (Table 6 and Figure 8). Like 40 other states, Kentucky must import large quantities of petroleum products and natural gas. In 1980, the U.S. imported 6.8 million barrels of oil

Table 4. Major Permits Required for Synfuel Facilities

Emission	Permit	Authority
Air	Prevention of Significant Deterioration (PSD) New Source Review	State/Federal
Water	National Pollution Discharge Elimination System (NPDES)	Federal
	Dredge and Fill (404)	Federal
Solid Waste	Resource Conservation and Recovery Act (RCRA)	State/Federal

Table 5

Federal Environmental Laws Affecting Coal Conversion Plants

Clean Air Act
Clean Water Act
Safe Drinking Water Act
Toxic Substance Control Act
National Environmental Policy Act
Resource Conservation and Recovery Act
Occupational Safety and Health Act
Endangered Species Act
Noise Control Act
Rivers and Harbors Act
Fish and Wildlife Coordination Act
National Historic Preservation Act
Wild and Scenic Rivers Act
Non-nuclear Energy Research and Development Act
Surface Mining Control and Reclamation Act
Executive Order 11988 Floodplains Management
Executive Order 11990 Protection of Wetlands

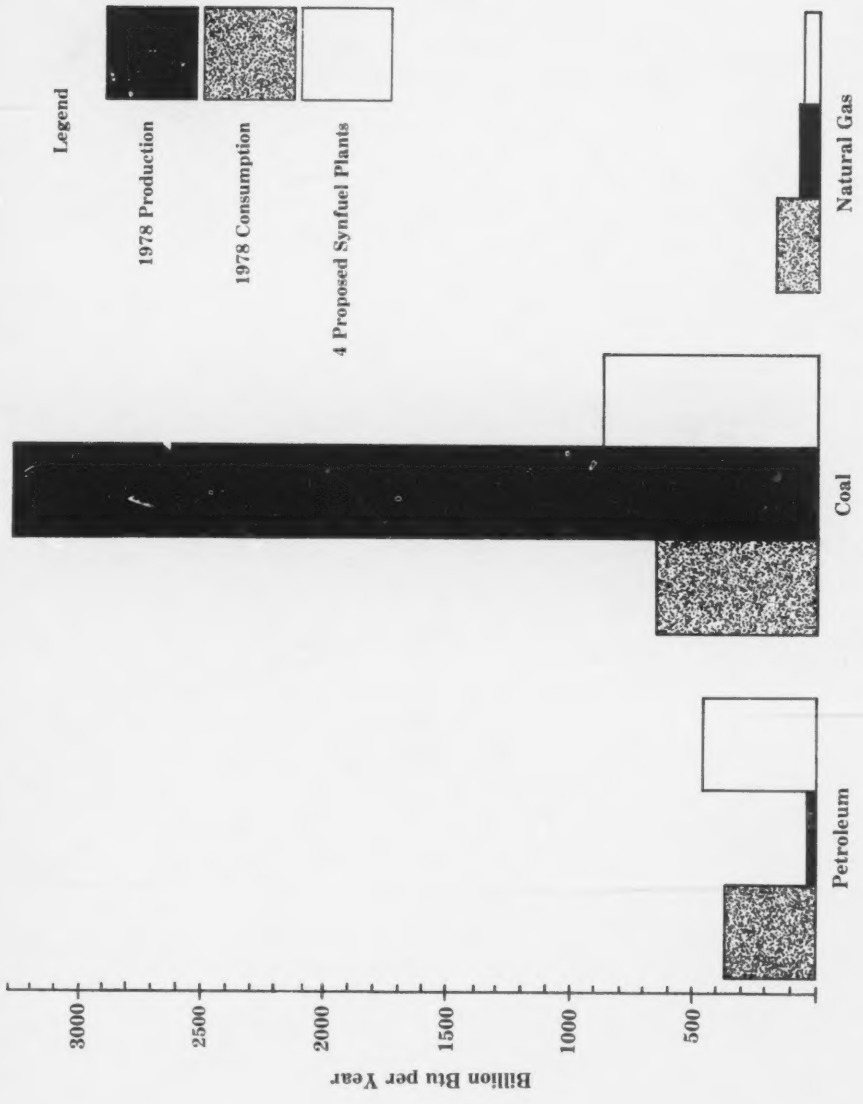


Figure 8. Kentucky Energy Summary

Table 6

Energy Comparisons: Kentucky Production/Consumption and the Proposed Synfuel Industry

Energy Type	Production	Consumption
Kentucky 1978		
Petroleum products (million barrels)	5.7†	71.7
Natural Gas (billion cubic feet)	70	189
Coal (million tons)	137	27
4 Synfuels Plants		
Petroleum Products (million barrels)	77	
Natural Gas (billion cubic feet)	57	
Coal* (million tons)	37	

* All of the coal is consumed or converted in the synfuel plants.

† Crude oil production

per day - Kentucky's needs were equivalent to about 10 days' imports. Production within Kentucky was 37% of the state's natural gas and 8% of the state's oil consumption.

The following discussion is an attempt to develop a perspective for assessing the significance of the energy production from the four proposed synfuel plants. The output of these plants may be conveniently compared with the State's current levels of production and consumption (as well as known reserves) of liquid and gaseous fuels. The comparisons are made solely to gauge the significance of the output and not to imply that fuels produced in Kentucky will necessarily be consumed within the State.

Kentucky's known reserves of oil and natural gas are small in comparison to its needs:

- less than a one year supply of oil and
- less than a 4 year supply of natural gas (at 1978 consumption rates).

In contrast, the State has abundant coal resources. The reported coal reserves of 65 billion tons represent about 1,560 Quads (10^{15} Btu) - this is the Btu equivalent of 1,280 years of energy consumption in Kentucky (at the 1978 rate). With the development of a synthetic fuels industry the state could become a major producer of petroleum products and substitute natural gas (SNG).

The yearly production totals for the four plants are shown in Table 6. On a Btu basis the output of the synfuel industry would increase the state's petroleum production by over 14-fold and gas production by 80% (Figure 8). The liquid fuels output of the 4 plants is greater than the amount currently consumed in Kentucky. The plants could supply 42 million barrels of gasoline per year, which is nearly equal to Kentucky's 1978 consumption (45 million barrels). On a national scale, the synfuel outputs could offset 13 days worth of oil imports, which is roughly equivalent to reducing the balance of payments by $2.6 billion per year (at $30/barrel).

Very few other alternative energy sources presently available could provide such significant quantities of oil and gas. For example, to produce the same Btu output from corn would require about 300 ethanol plants (each at 20,000,000 gallons/year) and would use about 40% of the annual U.S. corn production.

III. DESCRIPTION OF REPRESENTATIVE COAL CONVERSION FACILITIES

Coal conversion plants will be very large industrial facilities. In terms of coal use, for example, commercial size conversion plants are being designed to handle and process more coal per day than even the largest coal-fired steam-electric power plants. The plants are sized to take advantage of "economies of scale" which make larger plants more efficient to operate and result in cheaper product costs.

This chapter discusses a number of characteristics of a representative commercial size coal liquefaction plant. Because there is not a great deal of familiarity with synthetic fuel plants, comparisons are made throughout with coal-fired power plants. These two industry groups together may account for most of the industrial development and the majority of the coal used for the next two decades in western Kentucky. Many of the numbers reported must be viewed as estimates since the synfuel plants have not yet been built. We have used values based on actual plant designs, the available published literature, applicable control technology and environmental standards. More detailed data for each specific project can be found in Chapter II. In general, gasification and indirect liquefaction plants will be of similar size and have characteristics similar to direct liquefaction plants. We have indicated those areas where differences are expected. The plant characteristics are listed in Table 7 and are discussed in some detail below.

Operating Factors

A commercial scale liquefaction plant will convert 20,000-30,000 tons/day of coal. For a consistent analysis, a throughput capacity of 30,000 tons/day is assumed for a prototype liquefaction plant. Other assumptions include:

- the use of an Eastern Interior Basin high-sulfur (3.5% S) bituminous coal (12,000 Btu/lb).
- on-site generation of steam and electricity (requires 15-25% of the coal feed).

Present day power plants in the western Kentucky region are being designed for 800 to 2,600 MW of capacity per station (unit size varies from 400 to 1,300 MW with at least two units per station). A 1,000 MW station has been chosen as the typical plant for the purpose of this discussion. Since these plants will be located in the same coal-producing area as the liquefaction plants it is assumed that the same kind of coal will be used.

The liquefaction plants will be designed to operate at full capacity 24 hours per day, 7 days per week, 330 days per year which gives a combined annual capacity factor of 90%. The remaining 10% of the time is allowed for shutdowns for scheduled maintenance and upsets and for operation at less than full capacity. By contrast the power plants are restricted to load-following operations – electricity is only produced in response to the consumer

Table 7
Characteristics of Coal Conversion Facilities

Characteristic	Coal-Fired Power Plant	Coal Liquefaction Plant
Nominal size	1,000 MW	30,000 TPD of coal
Capacity factor	70%	90%
Coal use	7,000 TPD	27,000 TPD
Conversion efficiency	34%	75%*
Daily product output	17 million KWH or 57 billion Btu	84,000 barrels of oil or 490 billion Btu*
Cost of plant (1980$)		
total	$1-1.2 billion	$3-4 billion
per 1000 Btu/day of product capacity	$12-15	$6-8
Peak construction labor force	1,000-1,500	5,000*
Construction period	4-6 years	5-7 years
Operating labor	200-250	1,500
Water consumption†	10 million gal/day	12-18 million gal/day
Water discharge†	0-1.5 million gal/day	0-3 million gal/day
SO_2 emissions†	50 TPD	25-30 TPD
NOx emissions†	50 TPD	40-100 TPD
Particulate emissions†	2.5 TPD	2-4 TPD
Solid waste (dry basis)†	1,600-2,000 TPD	3,000-4,000 TPD
Land Use		
facilities	200 acres	500-1,000 acres*
waste disposal	250-300 acre-feet/yr	400-500 acre-feet/yr
total controlled site	1,000-2,000 acres	2,000-3,000 acres

* Differences for indirect liquefaction (see text).
† Based on annual averages.

demand – and due to the large difference between the peak and off-peak demands a portion of the plant capacity cannot be used. While typical capacity factors for power plants will vary from 50 to 75%, 70% has been selected for this analysis as representing a base load power plant.

Plant conversion efficiencies are calculated on the basis of the Btu value of the products divided by the Btu value of the coal input. The following range of efficiencies is expected: direct liquefaction, 70-80%; indirect liquefaction, 50-60%; and electric generation, 30-40%. Based on the capacity factors the average coal input is 7,000 tons/day for the power plant and 27,000 tons/day for the direct liquefaction plant.

Product Outputs

Liquefaction plants will produce various proportions of petroleum products (gasoline, fuel oil, and, other distillate cuts), synthetic crude oil, solid boiler fuel, methane (natural gas), and chemicals. The daily output of the prototype liquefaction plant will be 84,000 barrels per day of oil or oil equivalents (56,000 barrels per day for indirect liquefaction). For comparison, petroleum refineries process 100,000-300,000 barrels per day of oil. The Ashland Oil refinery at Catlettsburg has a capacity of 205,000 barrels per day. The power plant output averages 17 million kilowatt-hours per day. The liquefaction plant has 3 times the coal capacity of the power plant but will produce more than 8 times the output on a Btu basis due to its greater efficiency and capacity factor.

Plant Costs

Capital costs for liquefaction plants are estimated at $3-4 billion. These plant costs, while seemingly very large, are not out of line with other energy conversion facilities. The 1,000 MW power plant will cost about one-third as much, but the costs are roughly equivalent on the basis of coal capacity. The liquefaction plant will cost about one-half as much as the power plant on the basis of output capacity. The cost of nuclear power plants is somewhat higher than coal. Even for the more conventional and technologically-proven ethanol synthesis (corn-based production of 200 proof alcohol used in gasohol) plant costs are comparably high. A 20 million gallon per year ethanol plant costs $40 million and produces 4.6×10^9 Btu/day or $8.70/1000 Btu per day of output capacity. Comparable figures are $12-15 for a coal-fired power plant and $6-8 for a coal liquefaction plant.

Labor

The operating labor force for direct liquefaction plants will be approximately 1,500. The estimates for indirect liquefaction plants are somewhat higher – over 2,000 for the Fischer-Tropsch plant (Tri-State). About 10% of the labor force will be highly technical personnel, mainly engineers; the remainder are laborers, maintenance workers, and service and administrative people. The latter could be drawn largely from the local labor force. A number of additional contract workers will be required for maintenance and service. These labor figures do not include the miners needed to produce coal for the plant (discussed in Chapter IV). About 2 to 3 times more operating workers are required for the synfuel plant than for the power plant. Although a significant number of new jobs would be created by both of these industries, neither would be considered large by comparison with manufacturing plants which may employ 2,000-20,000 workers.

The construction work force for synfuel plants, however, will be significant. The building of four commercial plants in the next ten years could mark the largest construction effort ever seen in Kentucky. At present the largest construction projects in the U.S. are for coal and nuclear power plants. The largest project since World War II is underway at the present time in Tennessee at the TVA nuclear power plant in Hartsville. The work force there peaked at about 7,000. By contrast, the typical 1,000 MW coal-fired power plant would be built over 4 to 6 years and the labor force would peak at 1,000 to 1,500. Projections for coal conversion plants indicate a 5 to 7 year construction period and a peak force of about 5,000. An exception is the projection by Fluor Engineering Company that 15,000 workers will be required in the construction of a Fischer-Tropsch indirect liquefaction plant. At a similar project in South Africa - SASOL II - there were over 20,000 workers on-site at the peak of construction. These estimates leave considerable uncertainty which will be resolved as the engineering designs for the plants near completion.

Water Resources

The coal liquefaction plant, like the power plant, will be a major user of water: 12 to 18 million gallons per day (somewhat higher for indirect liquefaction). Most of the water (over 90%) is consumed in cooling processes and is returned to the environment as water vapor. The other major water use will be for solid waste disposal - SO_2 scrubber sludge, ash and gasifer slag will contain residual water when landfilled. Due to the large water needs synfuel plants are being sited along major rivers - the Ohio and Green Rivers in Kentucky. The rivers will be used both for transportation and as a source of water.

The water used by a typical liquefaction plant will be less than 0.02% of the average flow of the Ohio River at Evansville or about 0.2% of the average flow of the lower Green River. During critical periods of low flow (based on the 7 day-10 year low flows) the prototype plant will use up to 0.2% and 8% of the flow in the Ohio and Green River, respectively. The amount of water returned to the river from the plants will vary and will affect the total water withdrawals:

water withdrawal = water consumption + water discharge

The amount of the discharge returned to the river can be reduced by recycling this water within the plant. In the extreme case - total recycling - there will be no discharges from the plant. This is termed zero discharge. Most of the synfuel plants will be using zero discharge.

Air Emissions

Synfuel plants will be major sources of emissions (major sources being defined as facilities emitting greater than 100 tons/year) for all of the priority air pollutants: sulfur dioxide, particulate matter, nitrogen dioxide, carbon monoxide, and hydrocarbons. Nevertheless, the plants will have to meet strict emission standards which will require the use of modern and expensive air pollution control equipment. Nor will the plants be allowed to be built in any area where they will cause or contribute to an existing air pollution problem. A very well defined set of rules and standards, permits, and compliance procedures have been established to ensure that the air quality will continue to improve in areas with existing problems and that no significant deterioration of air quality will take place in pristine rural areas.

The air emissions from synfuel plants will be considerably less than for other coal-using industries. For example, the typical liquefaction plant will have less sulfur dioxide (SO_2) emissions than a modern, well-controlled 1,000 MW power plant while using almost 4 times as much coal. These emission rates appear almost insignificant when compared to those of existing industrial sources:

Source	**lbs of SO_2 emitted per million Btu of coal used**
Coal-fired power plants	
built before 1971	up to 12
built between 1971 and 1978	1.2
built after 1978	0.6
Liquefaction Plants	0.075 - 0.15

Most of the power plants in Kentucky were built prior to 1971 and emit between 5 and 6 lbs of SO_2 per million Btu of coal burned. A new power plant, even one burning high-sulfur western Kentucky coal (3.5% S) will have emissions of only about 0.6 lbs. When all the existing plants are replaced by new plants, the SO_2 emissions of Kentucky and the U.S. as a whole should be much lower than today. Since SO_2 emissions from synfuel plants are lower still, this new industry should not contribute significantly to an SO_2 pollution problem. The same considerations apply for the other major air emissions from the synfuel processes. A discussion of air emissions which will occur in trace amounts from synfuel plants - e.g., trace metals, organic compounds, radioactivity - is beyond the scope of this report and will be dealt with elsewhere.

Solid Waste

Synfuel plants will produce substantial quantities of solid waste. By far the largest amounts of waste will result from the mineral matter (ash) in the coal: Coal is typically 5-20% ash. Processing 30,000 tons of coal a day with 10% ash leaves 3,000 tons of ash for disposal. This ash may be in several forms, including boiler ash and gasifier slag. The latter is a glassy-rocklike material which is formed when the ash melts and fuses at the high temperatures of the gasifier. Another significant waste stream is the sludge resulting from sulfur dioxide stack gas scrubbing. All the above-mentioned materials have been tested and found to be nonhazardous for disposal by landfilling. Similar wastes are produced by coal-fired power plants. There are several other minor solid waste streams (sewage sludge, water treatment sludge, used catalyst) which may be of a hazardous nature. These will be disposed of in secured, well-designed and monitored landfills. Such facilities require special permits and numerous standards now exist to ensure that none of the hazardous material is released to the environment.

Land Use

The coal liquefaction process facility will require 500 to 1,000 acres of land. Again, the Fluor estimate for a Fischer-Tropsch direct liquefaction plant is higher - about 2,000 acres. The major process areas in terms of land utilization are the coal storage, water treatment, and product storage areas which may account for over half of the land use. Land is also required for solid waste disposal - up to 500 acre-feet/year. Using current techniques the waste could be buried to a depth of up to 50-100 feet. Thus the land required for 20 years of operation could be as little as 100-200 acres. Alternatives to landfilling this waste are being examined. These include their use in building materials, their return to the mine site, and their use in the reclamation of orphan strip-mine land. The controlled plant site area for synfuel facilities will be considerably larger than the minimum required for process and waste disposal areas. The same is true for power plants. The extra land may be useful if plant expansion is a possibility. The unused land also provides a buffer area around the plant. This is being encouraged by environmental regulations for public protection and also for protection against such nuisances as noises and odors from the plant.

Although the plant life for economic and depreciation purposes is usually taken to be twenty to thirty years, the facilities may be in operation or similar use made of the land for at least forty to fifty years. Comparable examples are electric power generating facilities which have been operating at one site in Kentucky for over forty years. No major power plant site has been retired from that use in Kentucky. The equipment and facilities have been modernized but the basic land use has remained unchanged. The site of the coal to ammonia plant which operated west of Henderson in the 1940s has passed through several owners and has seen several process variations, but the use remains forty years later as an ammonia distribution center. Likewise, other large demonstration coal conversion plants of the late 1940s and early 1950s have been incorporated into other types of chemical process plants, but the land use has remained much the same.

IV. LABOR IMPLICATIONS

The labor aspects of the development of a synthetic fuel industry are of major importance and require early attention for several reasons:

1) Labor availability will affect the success and timeliness of plant construction.

2) One of the state objectives in synfuel development is the creation of new jobs. Training and apprenticeship programs require several years lead time.

3) The schedule and the nature of the influx of laborers into the region will largely determine the socio-economic impacts and will be a major factor in transportation needs.

The various types of labor impacts are the on-site plant construction force, the off-site manpower required by support industries, the permanent plant operating staff, the coal mining manpower, and the secondary employment from induced growth and increased industrial activity. The construction labor impact will be the most significant in terms of number of people, timing, and the problems associated with the transient nature of employment. A typical full scale plant will require at least a five year construction period and a peak of five to six thousand construction workers. As shown in Figure 9 the Tri-State project estimates much higher labor requirements due to the greater complexity of the processes employed and extensive product processing. The construction curves for the Breckinridge H-Coal, Tri-State and SRC-I projects together with the curve generated by the KDOE for the Grace project were used as the basis for the construction labor curves shown in Figure 9. The data on which these curves are based should be used with caution because they are very preliminary. The unreliability of the schedules was discussed previously in Chapter II. The magnitude and shape of the curves is also subject to extensive change. Not only will the project planning labor curves change but the reality of project construction invariably causes the actual labor schedule to vary considerably from the projected curves. Factors which cause schedule variations include weather conditions, management approach of the construction contractor, labor factors, equipment and material delivery delays, and other unforeseen circumstances. A key determinant factor in the magnitude and duration of the construction peak, and the total construction time is whether the plant is built in modules which are completed sequentially and brought on stream as completed. That approach, which has the effect of lowering and extending the peak and lengthening the total construction time, is being considered for the Grace and Breckinridge projects.

The construction manpower curves shown in Figure 9 represent an optimistic or fastest possible and at the same time a worst case as it relates to certain impacts. Little could be done to accelerate the schedules beyond what is shown and recent experience with major energy facilities indicates that projects are likely to experience delays, perhaps lengthy. Slippages in project schedules from those presented in this document already appeared certain as the report was being finalized. The peak of over 26,000 construction workers for synfuel plants results from the overlapping of the peak of construction in the Tri-State,

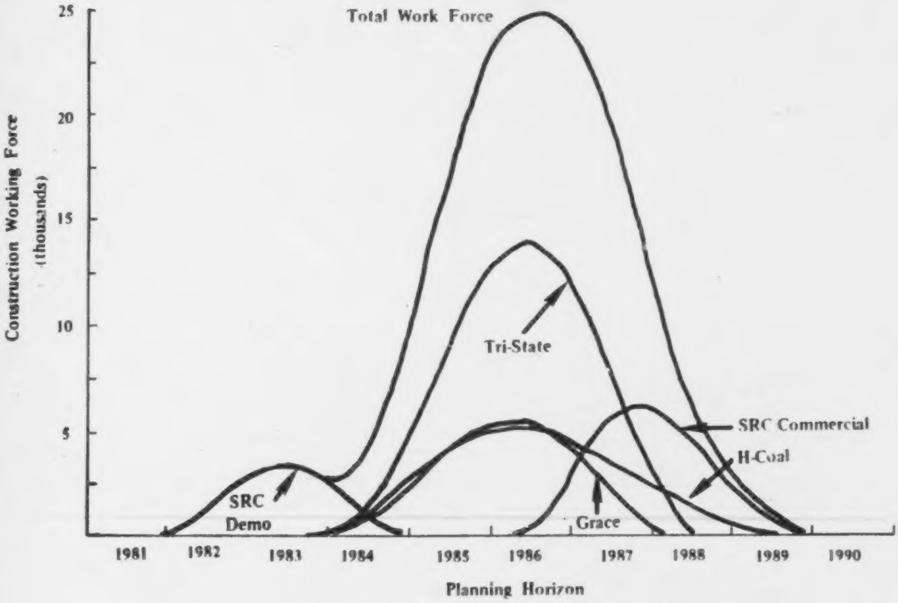


Figure 9. Synfuel Plant Construction Labor Requirements

Grace and H-Coal projects. According to current studies that peak would occur in late 1986. Any separation of these overlaps in these projects or a lengthing of construction periods will reduce that peak. However, if all four projects are constructed, it is likely that the peak labor will fall in the range of 15,000-20,000 at some point in time.

The construction labor requirement for the five coal-fired electric power plants which will be in construction in the 1980s is shown in Figure 10. A peak of 5,500 workers is shown occuring in 1983, but the same caution should be exercised in the use of these projections as with the synfuel plants. The slippage of power plant construction has been the rule rather than the exception in recent years, primarily due to growth rates of electricity consumption at much lower than anticipated levels. It is not unusual for plant schedules to slip several years and five years is not uncommon. Figure 11 shows the total construction labor requirements of the power plants and synfuel plants. While the power plants have little impact on the total peak number, particular plants may be competing for available labor at times due to location and schedule. The schedules also indicate that there should be a sizable work force in this area from power plant construction which may be available to synfuel plants. The craft distribution at peak construction for two power plants and four synfuel plants and a typical chemical process plant are presented in Table 8. That data indicates that most of the craft requirements for a power plant and a synfuel plant are similar with the exception

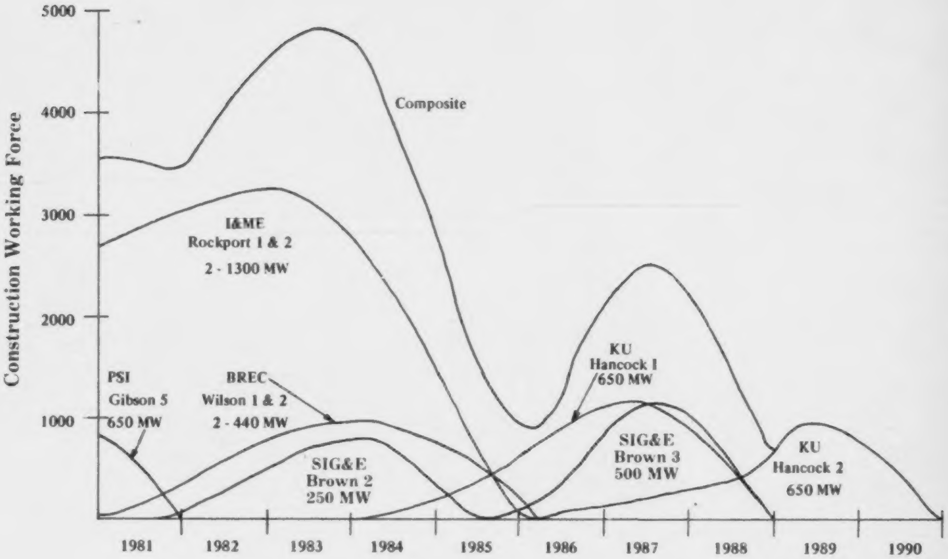


Figure 10. Power Plant Construction Labor Requirements

of iron workers and boilermakers which are more heavily required by power plants and pipefitters which are more heavily required by synfuel and process plants.

Of the four West Kentucky plants, only the SRC-I plant has advanced to the point of having labor craft loading schedules (i.e., a projection of the number of construction workers in each craft on the construction site at any time during the project). Therefore, it was necessary to develop generalized curves based on the SRC-I data which could be used as a preliminary estimate of the craft requirements of each of the other projects. The craft requirement schedules were then determined for each of the other three projects. The most dominant feature of that set of curves is the requirement for pipefitters which typically make up 40% of the total labor requirement. At the peak of the projected construction over ten thousand pipefitters will be required by the synfuel industry.

The permanent operating staff, which is typically on the order of 20% of the peak construction force, will begin to come on the site at mechanical completion of the plant and approach full staffing during the shake-down and start-up periods. The construction may draw heavily from outside of the immediate area, either commuters or transient workers. On the other hand, the number and skill requirements of the permanent operating force will allow for a much larger percentage of local hiring. As Table 9 indicates, the skills for the operational phase for many of the permanent force are not as specialized as the craft requirements for construction. The operating and maintenance work force will typically make up 80% of the total permanent work force. The majority of these positions can be filled by local persons who could be trained during plant commissioning and shake-down before actual operations commence. The remainder of the work force will be supervisory and administrative as shown in Table 9. The permanent employment impact of the synfuel industry is shown in Figure 12. The coal mining labor, also shown on the figure, will make up about half of the total permanent jobs. The geographical distribution of the two labor groups will be different. The plant labor force will be concentrated within commuting distance of the plant whereas the coal mining labor will be distributed more widely as discussed in the coal supply section.

Table 8

Construction Craft Distribution for Power, Synfuel and Chemical Process Plants (%)

Craft	Power Plant[1]	Chemical Process Plant[2]	Synfuel Plant
Insulators	5	3	5
Boilermakers	16	6	5
Masons	1	*	*
Carpenters	8	4	7
Electricians	11	6	8
Iron Workers	12	7	7
Laborers	12	12	7
Millwrights	3	—	3
Operating Engineers	9	7	8
Painters	2	4	2
Pipefitters	14	32	40
Sheet Metal Workers	1	*	*
Teamsters	1	*	1
Other	5	19	7

* Included in Other.

[1] Average of a Big Rivers Electric Cooperative and of Basin Electric power plant.

[2] from "Process Plant Estimating, Evaluation and Control," Kenneth M. Guthrie.

Table 9
Typical Composition of Synfuel Plant Operating Force

	% of Total
Laboratory	4
Engineering	4
Administrative and Management	8
Environmental, Health, Security and Safety	4
Operation and Maintenance	80

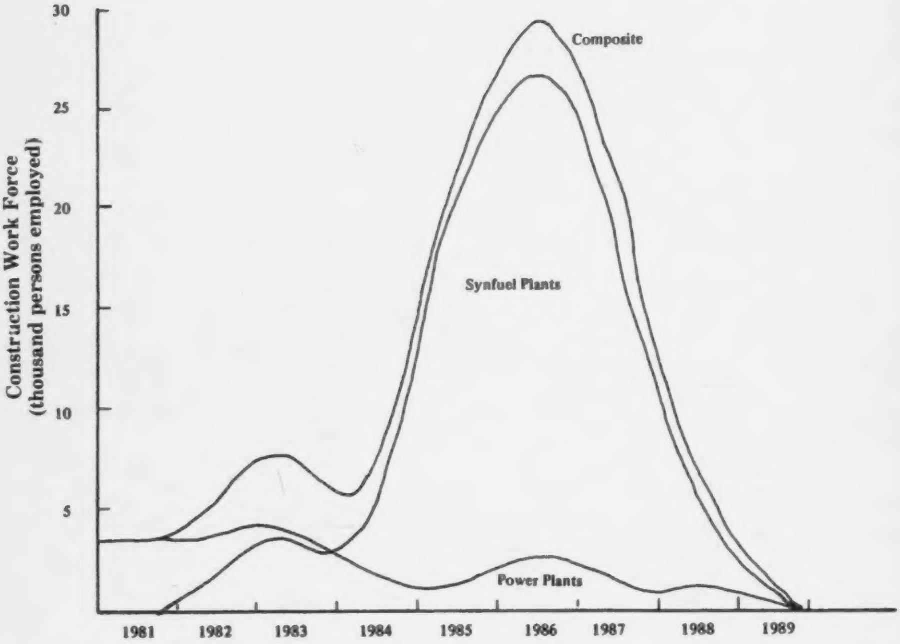


Figure 11. Total Power Plant and Synfuel Plant Construction Labor

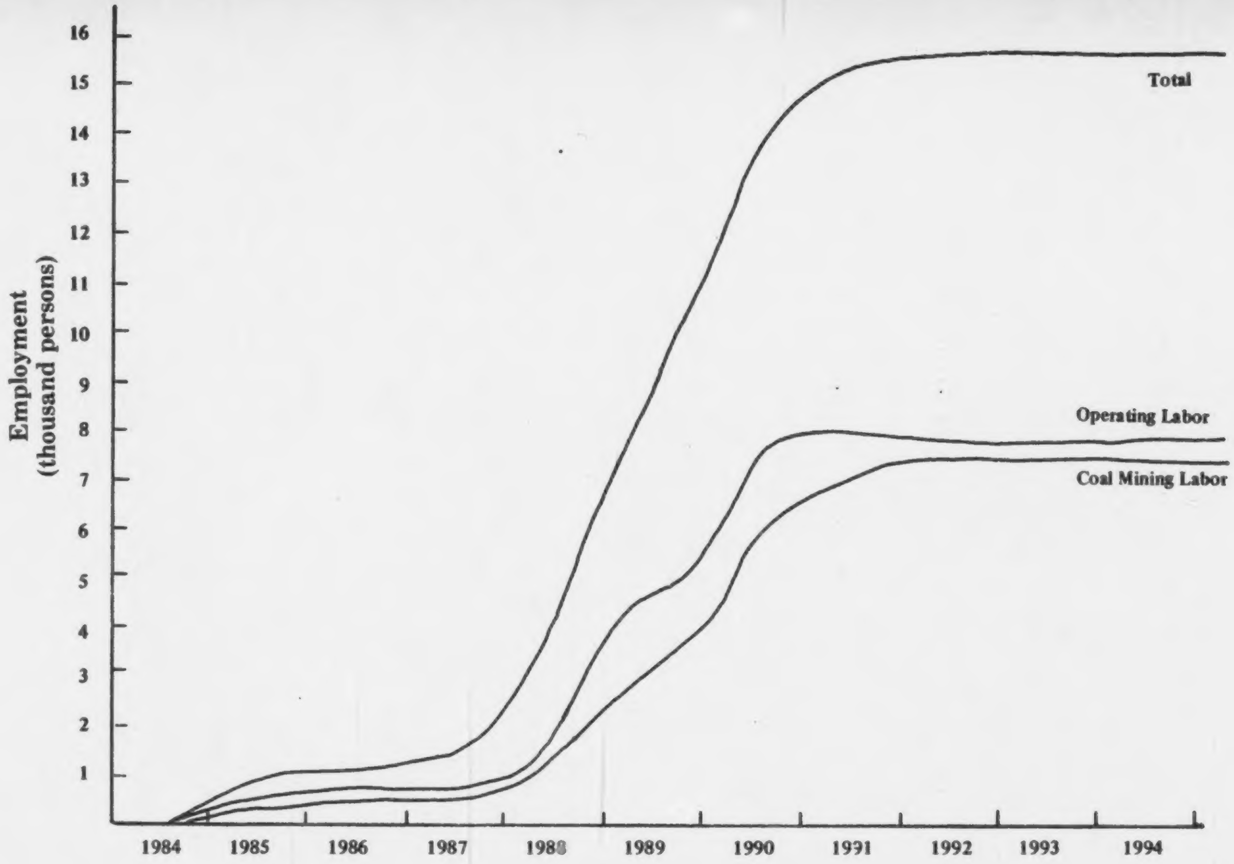


Figure 12. Synfuel Plant Operating and Coal Mining Labor

up about half of the total permanent jobs. The geographical distribution of the two labor groups will be different. The plant labor force will be concentrated within commuting distance of the plant whereas the coal mining labor will be distributed more widely as discussed in the coal supply section.

One of the key factors that determines the severity of the post construction "boom" impacts is the ratio of the peak construction labor impact to the permanent jobs created. Both the construction and permanent jobs are plotted on Figure 13. The ratio of the construction peak (26,000) to the total permanent labor (16,000) is 1.7 to 1 which indicates that from a state and regional perspective the impact (taxes generated, total population, etc.) caused by the transient nature of the construction peak would not be nearly as severe as it would if only a small permanent work force remained. However, in the area in the vicinity of the plants, the ratio could be as high as 3.3:1 (26,000 construction:8,000 plant operating) indicating that severe impacts are possible and that careful analysis and planning will be required. All of the ratios represent "worst case" situations as discussed in the schedules section. The actual peak of construction labor could be as low as 15,000 even with all the plants being built; therefore, the ratios and, thus impacts discussed previously will in all likelihood be much lower.

Coal consumption will begin to become significant by 1987 and the requirement of all four plants by 1990 will be over 112,000 tons per day. Assuming the plants operate at an annual 90% capacity factor the yearly consumption will be 37 million tons, 90% of the 1980 West Kentucky production.

The employment in the coal industry to meet the production for synfuel plants will be a major source of permanent (non-construction) jobs directly resulting from the synfuel industry. As Figure 12 illustrates the number of miners required will be only slightly lower than the number of persons employed by the plants. The number of miners required will depend upon the location, type, and size of the mining operations which have not been estimated. For the most recent year of record (1979) the split was 54% surface and 46% underground. Based on this data, the coal for synfuel plants is likely to come more heavily from surface than deep mines in the early years of the industry. Forecasts are that the trend is changing and the percentage of coal coming from deep mines will dominate in the later years of plant operation. To obtain a preliminary estimate of the number of miners that may be required for the production of coal for synfuel plants the current (1979) split between surface and deep mined coal was assumed. The productivity figures that were applied to this were 22 and 11 tons per miner per day for surface and underground mines, respectively. The two productivity figures were applied to the coal demand curve, Figure 14, to give the coal miner labor curve, Figure 12. When all of the plants are in operation in the early 1990s on the order of 8,000 (plus or minus 20%) persons in the coal industry will be required. There are some 12,000 coal miners in the West Kentucky coal industry and it is estimated that of those, approximately a thousand are currently unemployed.

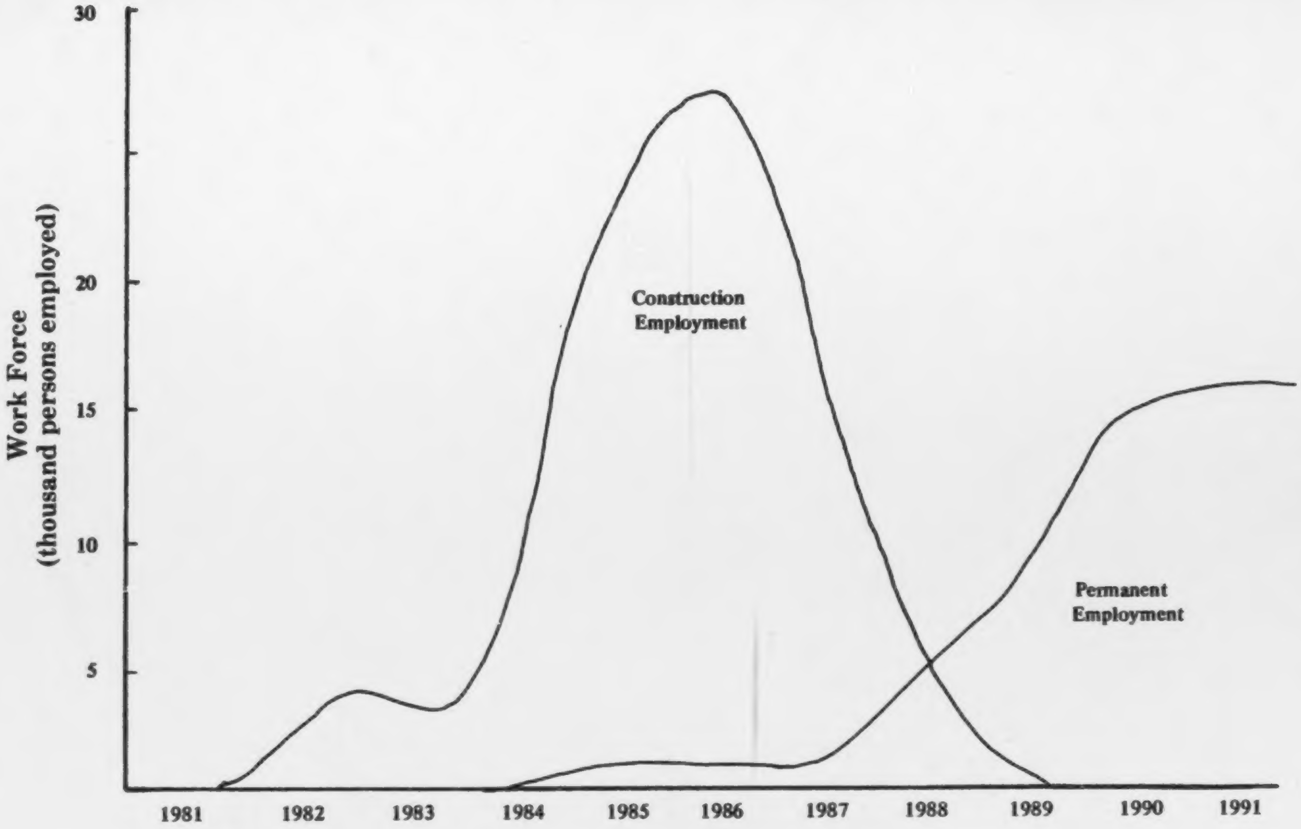
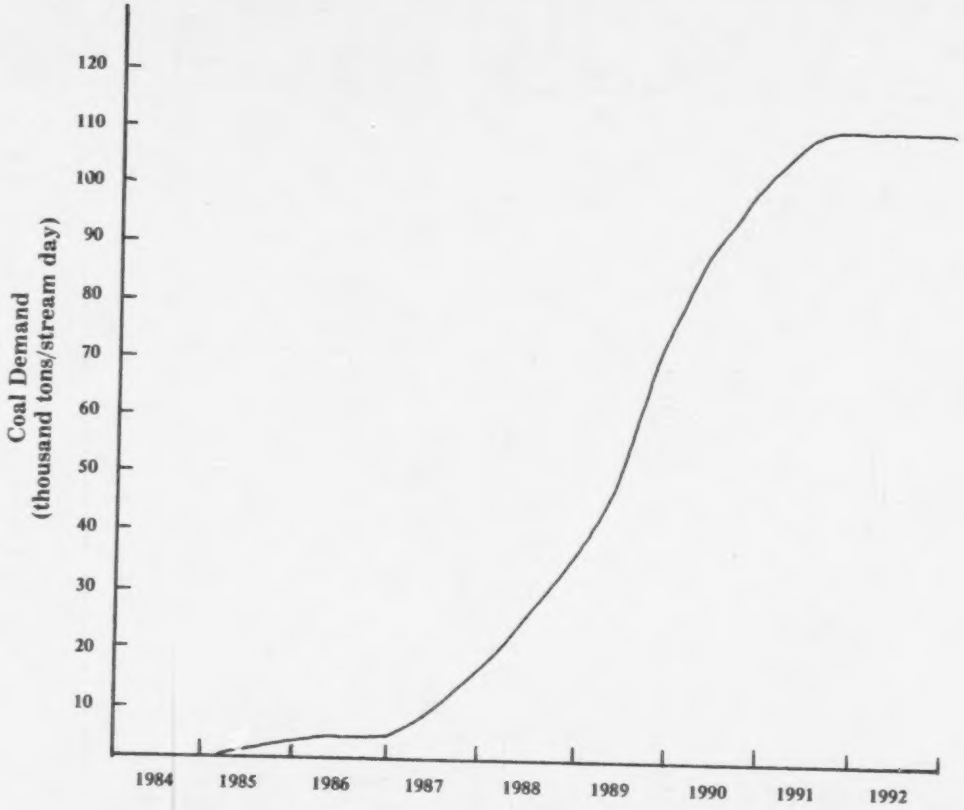


Figure 13. Synfuel Construction Employment and Permanent Employment



Source: KDOE

Figure 14. Coal Consumption in the Synfuel Industry

V. COAL SUPPLY

The synfuel industry in Kentucky will create a major market for coal which should be stable over at least the next thirty years and in all probability well beyond. The growth in coal demand related to the synthetic fuel industry will come from:

(1) the synfuel plants for processing and for producing steam and electricity

(2) power plants to provide part of the synfuel plant electrical requirements

(3) power plants to meet the electrical requirements of residential, commercial, and industrial growth induced by the synfuel industry

(4) direct consumption from industries which locate in the area because of the availability of synfuel products and byproducts (e.g., refineries and chemical plants).

Only the first two of these demand sectors have been quantitatively considered in the first phase of the assessment because they will dominate the total coal requirements and the future growth factors that will determine the latter two are not known at this time.

The coal demand data for the synfuel plants given in Table 2 indicates that the commercial plants will each consume approximately 20,000 - 30,000 tons per day of coal. The coal required for steam and electrical power production ranges from 15 to 25 percent of the total plant requirement. For some of the plants, a portion of the coal may actually be consumed by an offsite power plant and the electrical power then purchased by the synfuel plant. The decision whether to make or purchase electrical power will be made during the design phase of the project and will be based on economic, environmental, and other factors.

The rate of growth of coal consumption by the synfuel plants (assuming all power generated on site) is shown in Figure 14. The first coal will be required by the SRC-I demonstration plant in 1984, and coal requirements will increase rapidly as the Tri-State, Grace, and the Breckinridge H-Coal projects come into operation during 1987 and 1988. When all of the commercial size plants reach full operation in the early 1990s a total of 112,000 tons per day (37 million tons per year) will be required. The coal demand curve in Figure 14 assumes that coal for plant operation is stockpiled several months before plant completion and that the plant reaches full capacity one year after startup.

The synfuel plants are located on waterways with excellent barge capacity and on rail lines; therefore, it is reasonable to assume that some percentage of the coal will come from outside of Kentucky, primarily southern Illinois and Indiana. However, the design coals for the plants are West Kentucky coals which will in general have a transportation cost advantage over other coals. The existing coal-fired electric-power plants in the West Kentucky coal fields should give an indication of what the geographical distribution of the coal source for the synfuel plants may be. Power plants located in or near the West Kentucky coal fields purchased over 81% of their steam coal from West Kentucky mines in 1979. However, because of air pollution regulations some low sulfur compliance coal is used by power plants in the region, and such low sulfur coals are supplied from outside of the region. There is no analogous reason for synfuel plants to use low sulfur coal (as described previously); therefore, a more appropriate basis for comparison would be to consider those coals which are purchased without regard to sulfur content. Of the Illinois basin coals purchased by area plants (90% of the total coal) over 90% came from West Kentucky. For coals purchased by area plants having over 3% sulfur content (66% of the total coal) over 99% came from West Kentucky (see Appendix B). Therefore, until further analysis is done and purchasing plans are known it is reasonable to assume that on the order of 90% of the coal used by the Kentucky synfuel plants will come from West Kentucky.

To put the requirement of the synfuel industry - 37 million tons per year - into perspective the historical production of that region is shown in Figure 15. A peak of 53.5 million tons per year was reached in 1976 but production declined to 41 million tons per year in 1980. That decrease in production has been due primarily to air pollution regulations which restrict the amount of sulfur that electrical power plants can emit. The power plant market has consumed over 95% of the West Kentucky output in recent years. The synfuel industry by 1990 would increase the 1979 total coal production to about 88 million tons per year, 35 million tons or 65% more than the previous record year of 1976. While these figures do not reveal how the additional production will be met, how much will come from excess capacity in producing mines, how much from mines that could be reopened, how much from new mines, or how many mines of what type and size and the geographic distribution of those mines (all of which are to be examined in the following phases of the assessment) - they do allow several observations:

(1) The production of 88 million tons per year is attainable based on past production.

(2) The basic infrastructure exists for supporting such production levels. That infrastructure includes mining companies, communities in which the labor force can live, a pool of experienced miners, and transportation systems for conveying the coal to markets.

Obviously to increase production from the current level of 41 million tons per year to 88 million tons per year over the next decade will require a significant increase in mining activity - an average annual growth rate of 7.6% over the decade. The data in Figure 15 indicates that such a growth rate is attainable based on the previous rate of output experienced during the 1965 to 1975 period.

The West Kentucky coal resource data shown in Table 10 indicates that production for synfuel plants and other uses will not be constrained by the coal reserves. The resource total of 38 billion tons would support a 37 million ton per year synfuel industry for about 500 years at a 50 percent recovery factor. A total coal output of 88 million tons per year could be maintained for about 250 years. While the recoverability factors and future consumption rates are not known it is apparent that any reasonable set of assumptions indicates reserves on the order of hundreds of years to support any foreseeable level of output. Three major transitions have occurred in the nation's past as illustrated in Figure 16 which shows a switch from wood to coal to gas and oil as the primary energy sources. Most long range forecasts such as Figure 17 show that we are in a transition from fossil fuels to nuclear and other renewable energy sources (labeled as ultimate sources). Fossil fuels and synthetic fuels from coal are widely viewed as playing a major role only for the next fifty to one-hundred years. Thus, it is unlikely that more than 20% of the coal resource will be consumed for energy uses, leaving an ample supply for the chemical and other raw material uses of future generations.

The specific coal sources for the synfuel plants have not been identified at this time. A projection of the likely source of coal by county for the synfuel plants will be included as part of subsequent phases of the synfuel assessment. However, an examination of the county reserve and historical production data should give some insight into the likely supply patterns. Table 10 lists the county reserve data and Figure 15 shows the historical production trends. The coal for the first years of operations of synfuel plants may be more likely to come from counties which have a high level of mining activity and/or have shown an increased rate of production in recent years such as Muhlenberg, Hopkins, Ohio, and Union counties, while the coal for the later years of operation may come additionally from counties which have large reserves and have not had large production in the past such as Webster, Daviess, Henderson, and McLean counties.

The transportation, labor, economic, and environmental issues related to coal supply are addressed in separate sections of the report.

Table 10

Coal Resources of Western Kentucky

County	Remaining Resource (1978) (million tons)	County	Remaining Resource (1978) (million tons)
Breckinridge	0.3	Henderson	6,820.7
Butler	404.6	Hopkins	7,935.1
Caldwell	67.1	McClean	3,553.5
Christian	63.3	Muhlenberg	3,742.3
Crittenden	41.6	Ohio	1,604.0
Daviess	1,307.8	Union	6,382.5
Edmonson	158.4	Warren	8.1
Grayson	104.9	Webster	6,264.7
Hancock	167.6		
		Total	**38,626.6**

Source: *Western Kentucky Coal Resources*, September 1978, G.E. Smith and R.A. Brandt.

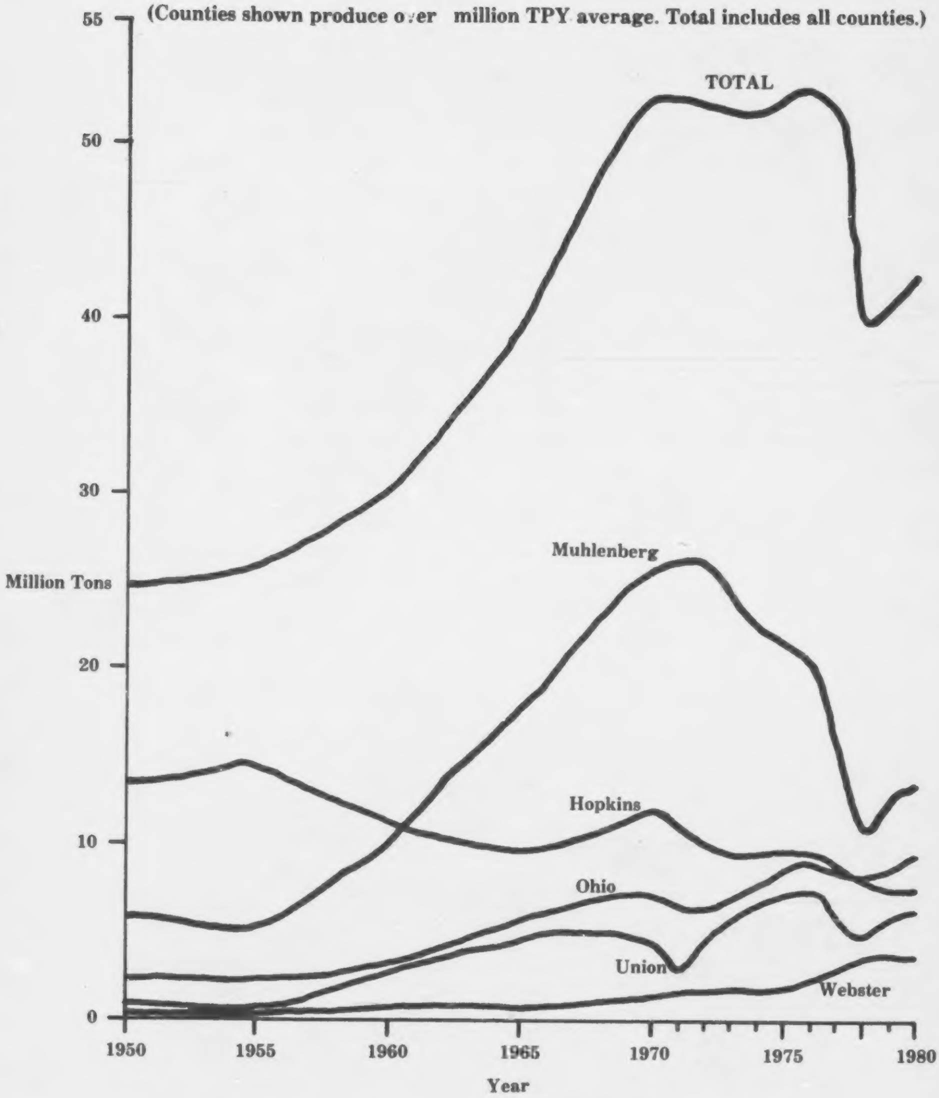


Figure 15. Historical West Kentucky Coal Production

Source: Kentucky Department of Energy.

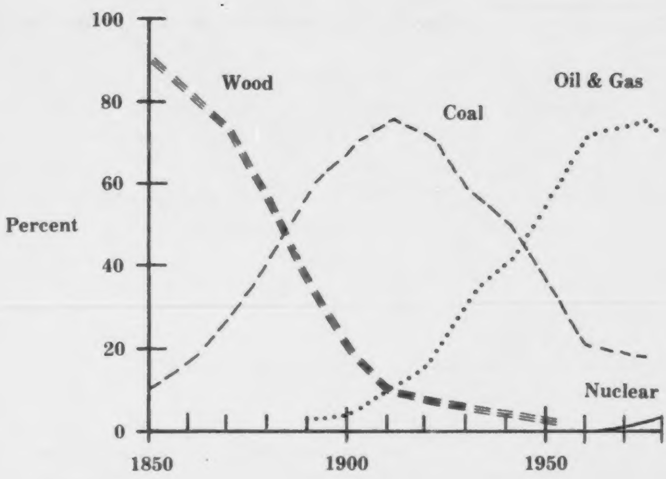


Figure 16. Major Energy Sources, 1850-1974
Source: ERDA 1975, p. S-2.

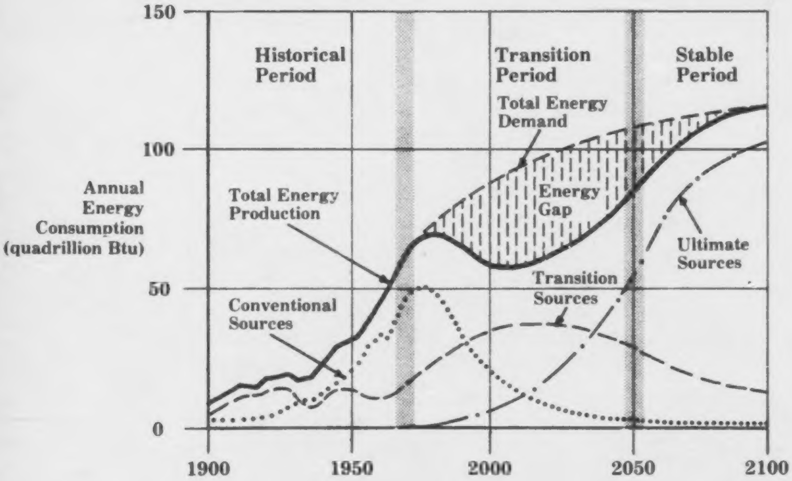


Figure 17. The United States Energy Transition
Source: *Managing the Energy Transition*, R.F. Naill, 1977.

VI. ECONOMIC IMPLICATIONS

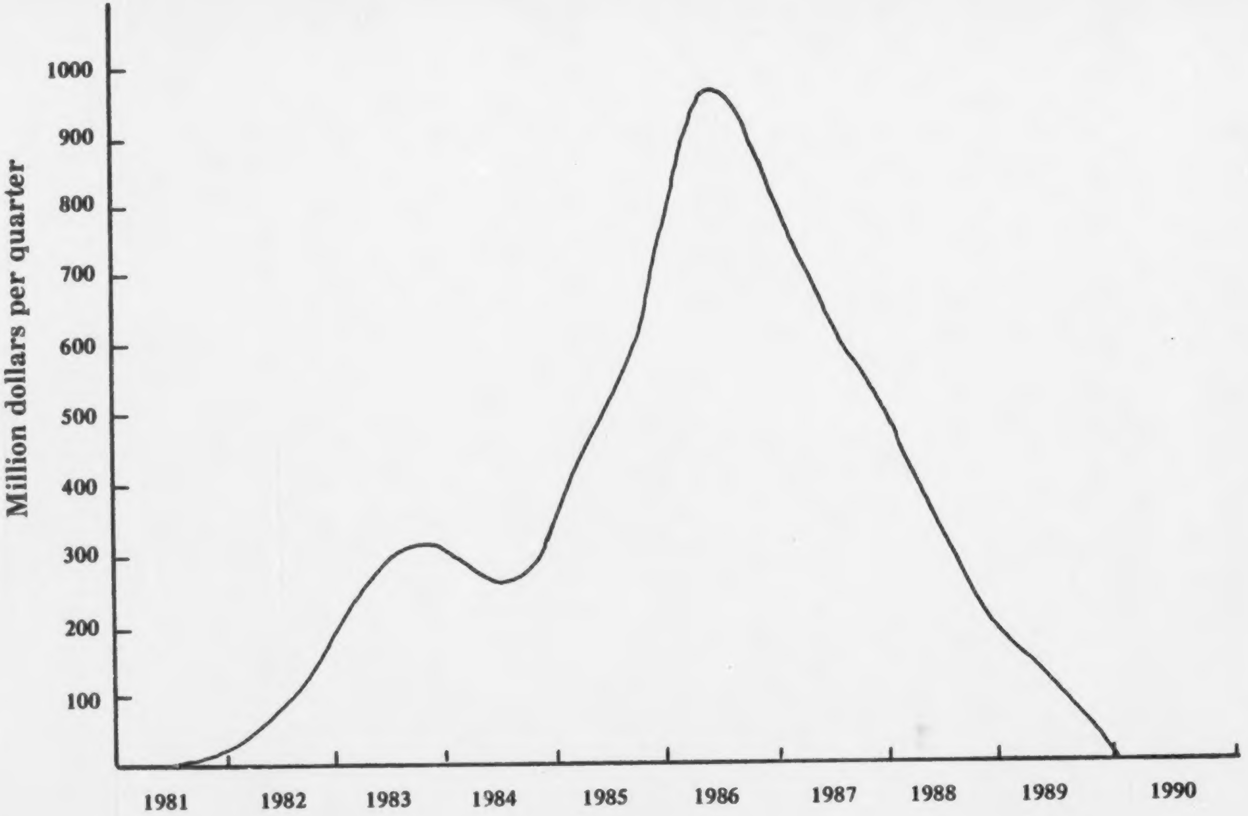
One of the three primary objectives of the Commonwealth in building a synthetic fuels industry is economic development. The economic activity from the plant construction, the direct wages, coal revenues, and taxes will be described. The cost associated with the industry such as road construction, schools, and other services will require much more detailed analysis and is being addressed by the Green River Area Development District study which is underway and by the appropriate state government agencies.

The capital investment in facilities will be unprecedented in Kentucky in terms of magnitude, concentration, and timing. Figure 18 illustrates that the rate of investment will climb rapidly to a peak of one billion dollars per quarter in the 1985 - 1986 time period and then decline until 1990. The investment in synfuel plants in Henderson, Daviess, and Breckinridge counties will be $7, $4.5, and $2.4 billion respectively while the current total real property assessments in those counties are $0.77, $1.5 and $0.23 billion, respectively. The direct construction wages that will be generated are shown in Figure 19 and will also peak in the 1985 - 1986 time frame at over $200 million per quarter. The amount of economic activity that will be stimulated in the local economy (or capture rate) will be addressed in greater detail in later phases of the assessment.

The wages and income taxes on those wages of the coal mining and plant operating labor are shown in Figure 20. The approximate value of the coal consumed by the synfuel industry is shown in Figure 21. The severance taxes on that coal also shown in Figure 21 will be on the order of $43 million per year when all of the plants are in full operation. Previous analysis by the Kentucky DOE indicates that severance taxes make up about two-thirds of the total of all of the state taxes paid directly on coal production. Based on that percentage the additional state taxes that will be generated as a result of coal production for synfuel plants will be on the order of $14 million per year (in addition to severance and personal income taxes).

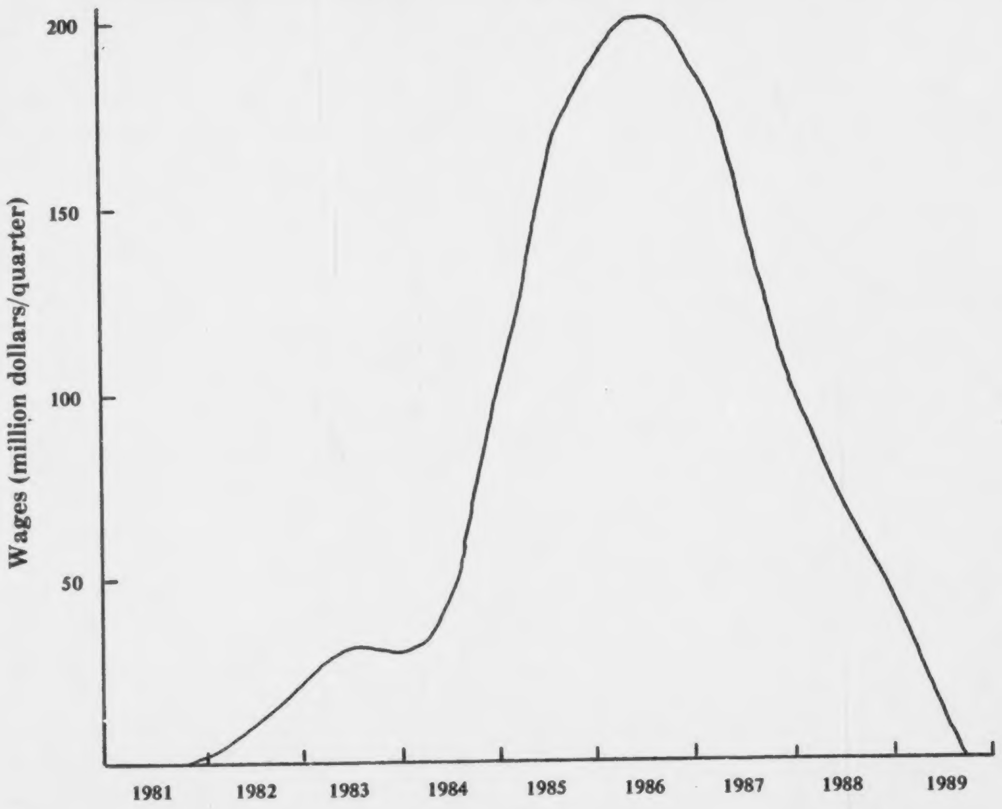
The type and value of the products from the synfuel plants vary widely, therefore, the total plant output of 260,000 Bbl/day of oil equivalents was used to estimate total product value. Assuming a product value of $35/barrel the four plants would produce products valued at $9.1 million per day. The value of the coal consumed (at $25 per ton) would be $2.8 million per day, therefore, the value is increased by a factor of approximately 3.3.

The synfuel plants will be producing a wide range of fuels, products, and byproducts which will attract a diversity of other industries in the future. Examples of such industries include metals industries, refineries, and chemical process plants. All of the basic ingredients required to support a petrochemical complex will be available in the area from the synfuel plants. Those basic ingredients - methane, synthesis gas, ethelene, propylene, aromatic hydrocarbons, natural gas liquids - will be produced in significant quantities. The type and extent of development downstream of the synfuel plants is beyond the scope of this report but is being examined by the Kentucky DOE.



Source: KDOE

Figure 18. Capital Investment in the Synfuels Industry



Source: KDOE

Figure 19. Synfuel Plant Construction Wages

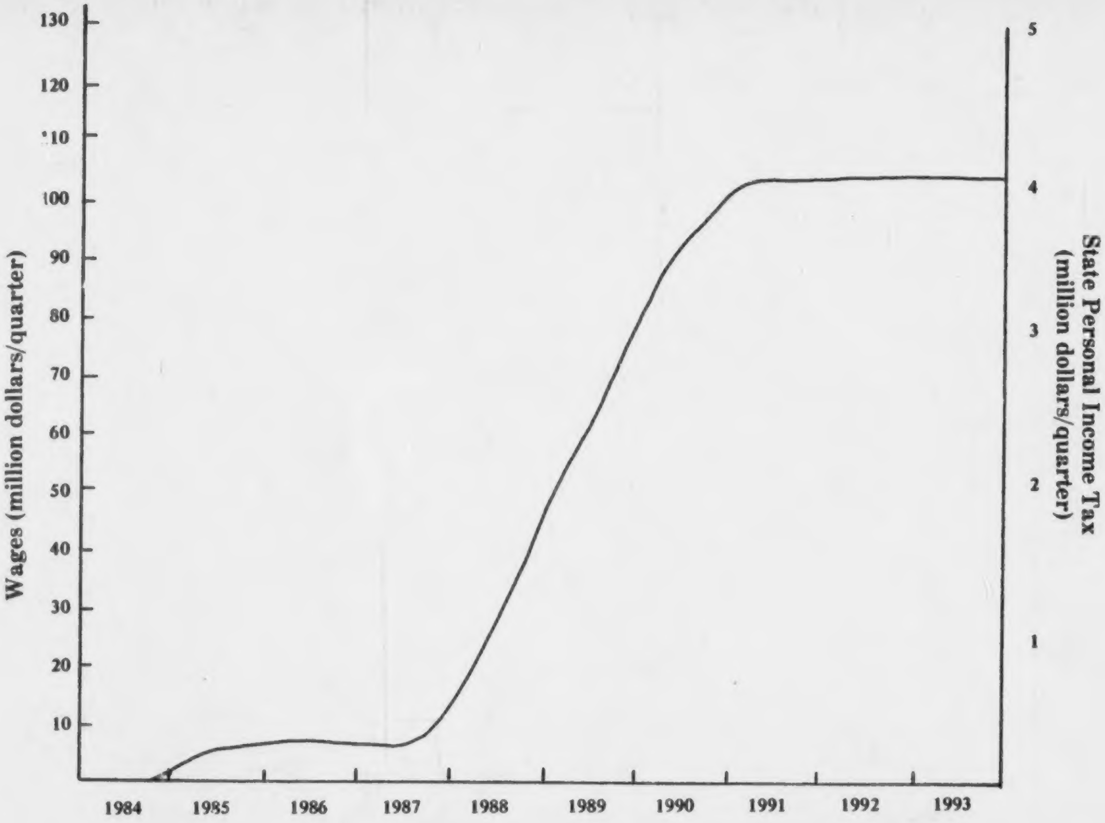


Figure 20. Wages and Income Tax from Permanent Synfuel Industry Jobs
(Direct Plant Operating and Coal Mining Labor)

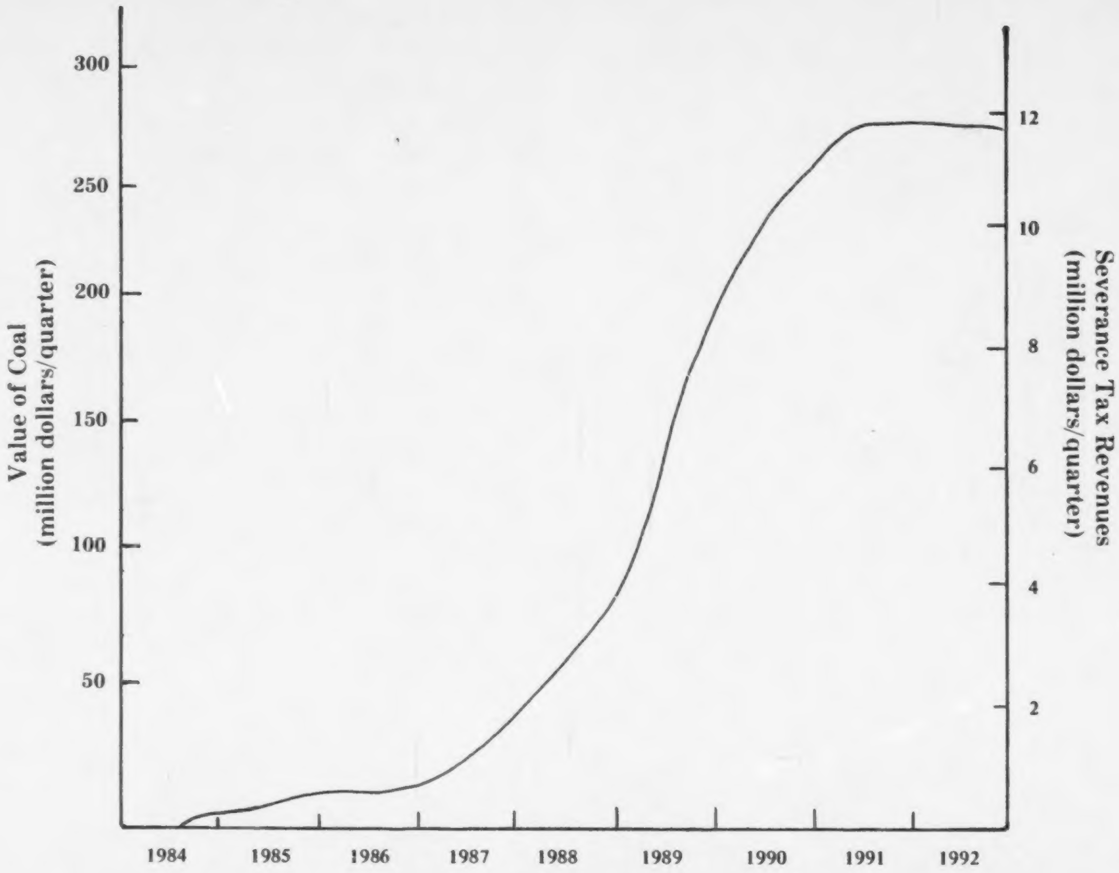


Figure 21. Value of and Severance Taxes Paid on Coal Consumed by Synfuel Industry

VII. TRANSPORTATION ISSUES

The movement of resources, products, and workers to and from the plants will rely largely on the existing transportation networks. Early planning will be essential in preventing severe strains on these systems. If the transportation system is not upgraded in time, local disruption and project delays may result. .

Worker Transportation

The largest traffic volume demand on the existing highway system will occur during the peak construction phase as a result of commuting workers. During the construction period the local highway system, if not improved, will not have sufficient capacity to carry the projected traffic loads.

Assuming a normal vehicle occupancy ratio of 1.2 persons per vehicle and a single construction shift on just the SRC site at Newman, peak hour traffic in both directions will be operating a a level of service "E." This level of service along U.S. 60 implies delays, low travel speeds, and little opportunity for making left turns or passing slower vehicles. The peak traffic period can be spread out by staggered shifts and/or the vehicle occupancy ratio can be increased through an intensive ride-sharing program to prevent the morning and afternoon traffic problems. A ride-sharing plan, primarily using buses to transport workers to and from the SRC site at Newman, is being considered as a partial solution to this problem. However, construction on the W.R. Grace project at Baskett could begin before the SRC demonstration plant is finished, thus, creating an overlap in the two construction projects and additional traffic on that highway.

It appears practically impossible to complete the widening of any segments of U.S. 60 by the time the first project begins construction in mid-1981. Using Federal highway funds, such a highway construction project requires a detailed project planning study and environmental analysis (taking at least two years, but probably longer), design (taking from one to two years), and right-of-way acquisition (taking at least from one to two years but probably longer) before construction can begin. While the use of state funds could shorten the planning and design phases, at least two to three years would be required before highway construction could begin. Such a schedule could serve to worsen the situation since the highway construction would create more delays for the construction workers commuting to and from the SRC or W.R. Grace sites.

The addition of the Tri-State project at Geneva makes a total of three commercial scale plants to be constructed within 20 miles of Henderson. Since Henderson is already experiencing some traffic problems, the effect of these plants could be severe. Since the project is scheduled to begin in about 1983, highway improvements could feasibly be completed in time. Such improvements include the possibility of upgrading U.S. 60 west of

Henderson to provide additional capacity and extension of the bypass from the Audubon Parkway to U.S. 60 to provide both extra capacity and an alternate route. Both of these projects can be justified in order to meet both short-range and long-range needs.

Although the H-Coal project in Breckinridge County is over 50 miles from the next nearest synfuel plant, it is within 20 miles of the proposed Kentucky Utilities power plant near Hawesville. Since both will be under construction between 1986 and 1988, traffic problems due to commuting construction workers should be expected along U.S. 60 between Hawesville and Hardinsburg and on KY 144 between U.S. 60 and the Breckinridge H-Coal site.

Coal Transportation

All the synfuel plants will have facilities to receive coal by rail, barge or truck. Most of the coal in Kentucky and other eastern interior coal fields has traditionally been shipped by rail. However, with the three plants located within the coal producing areas, other transportation modes may be more economical due to the short haul. Since industry plans are not firm at this time, only the general capabilities (and potential problems) of each system are discussed below.

The railroads will be counted on heavily for the movement of coal to the synfuel plants. The western Kentucky coal field is presently served by the Illinois Central & Gulf (ICG) and Louisville & Nashville (L&N). These two railroads moved about 35% of the 41 million tons of coal produced in western Kentucky in 1980. Substantial upgrading of the railroads as well as new rolling stock may be required to handle a large share of the additional 37 million tons per year required by the synfuel plants (plus part of the 15-17 million tons per year for the new power plants).

Due to the large coal shipments needed, all of the plants will probably be equipped to receive unit train operations, one of the most efficient coal hauling methods. To move 37 million tons of coal on a yearly basis will require 11-12 unit trains per day (unit trains of 100 cars; 100 tons of coal per car). Providing this many additional unit train operations will require an investment of $100 million in locomotives and rolling stock.

Much of the coal needs for the plants could be met by barge transportation. The Eastern Interior Basin is drained by numerous navigable rivers: the Green, Ohio, Mississippi, Kaskaskia, and Wabash. There is considerable unused capacity for coal movement on each of these.

Both the SRC and the W.R. Grace sites lie adjacent to the Green River, which carries just over 70% of all western Kentucky coal loaded on barges for shipment. The highest coal tonnage transported on the Green River in one year was about 16 million tons in 1970, and the average range during the last decade has been about 13 to 15 million tons annually. With the capacity of the Green River at approximately 60 million tons (and coal accounting for about 98% of the total tonnage), there is about 44 million to 47 million tons of unused capacity on the Green River alone. Practically all of the coal now being shipped on the Green River is bound for out-of-state destinations with the tonnage almost evenly divided northbound and southbound at the Ohio River.

The movement of coal to the sites by truck could place an added strain on the highways, reducing capacity further and leading to more rapid pavement deterioration. Only a small percentage of the coal is expected to come all the way to the plants by truck unless problems occur in the timely delivery by other modes; however, most of the coal will probably move from the mine to the tipple by truck prior to loading on to train or barge. Therefore, considerable damage could be done to "lower class" local roads or those which can least withstand the loads and which would place large demands on limited local funds for repairs.

Coal slurry pipelines have proven to be a feasible and economic alternative in certain instances, but usually only for long haul transportation. The disadvantages of this system are the amount of capital needed for implementation, the difficulties in obtaining rights-of-way, permitting, and the long lead times needed for planning and putting the new system in place. None are planned at the present time. The W.R. Grace project could be an ideal candidate due to its limited site acreage for coal storage and the fact that the design gasifiers (Texaco) can handle a coal slurry; however, a detailed economic analysis would be needed to determine its practicality.

Coal conveyors are another option available for minemouth operations and for the movement of coal from the railhead or river to the plant. The Tri-State project will move coal to the site from Texas Gas Transmission's reserves in Henderson County and conveyor systems will be considered. Conveyor systems also deserve consideration for the other projects.

Product Transportation

Synthetic fuel products fall into a number of categories: synthetic crude, blending stocks, chemical feedstocks, and finished products. In addition, the products include gases, liquids, and solids. The same transportation modes discussed above will be used to transport these products.

One major difference will be the increased role played by pipelines in transporting gaseous and liquid products. A pipeline system is already in place and gas, crude oil, and product pipelines are likely to be more energy efficient, more economical, and generally have less environmental consequences than other transportation modes.

VIII. SOCIAL ISSUES

Overview of Issues

Public attention and concern about the potential for adverse effects on a community's quality of life from economic development and growth is now focused on energy projects. It is important to develop a perspective regarding the impact of energy development projects. Without attempting to minimize the significance of the impacts, it is appropriate to emphasize that host communities also experience significant economic and other benefits as a result of energy development project location. Adequate planning and the development of local institutional capabilities determines the extent to which benefits are enjoyed. These benefits are largely economic, as discussed earlier, and include increased job opportunities with a concomitant decrease in unemployment and the financial and social strain that accompanies unemployment; increased economic activity in the region; increased economic value of Kentucky's coal resources through the use of the coal within the state; increased revenues for state and local governments; and, finally, an increased level of energy production. Other important benefits to local communities may be experienced. The development and the following population growth may result in:

1) the addition of new or expanded public facilities without the imposition of increased taxes in such areas as education, health care, public housing and water and sewage treatment, and solid waste disposal;

2) the addition of services and economic opportunities which may not have been possible in communities of more limited size (for example, a new hospital, a full time fire department, a public transportation system or shopping center);

3) the creation of new cultural and recreational opportunities (such as new libraries, museums, theaters, parks and playgrounds).

It is important to recognize that the social, economic and other costs as well as the benefits of energy projects vary enormously from site to site, and from region to region. The severity of impacts will depend upon such site specific factors as local population size and growth rates, population density in the host county and surrounding areas, proximity to regional centers of population, service and trade, local institutional capabilities to plan for, manage, and finance necessary infrastructure facilities. For example, there is already a growing body of experience and literature regarding the impacts of energy development, primarily in the western United States. As a result of the rapidity of the development and the rural character of much of the West, the impacts have been acute. With a population density of approximately 10 people per square mile, compared to the national average of about 60, many of the rural communities in the West have been ill-prepared to address the problems associated with the rapid influx of new population. The severity of impacts can be more easily mitigated in the urbanized areas of the eastern U.S. which have a greater existing labor force

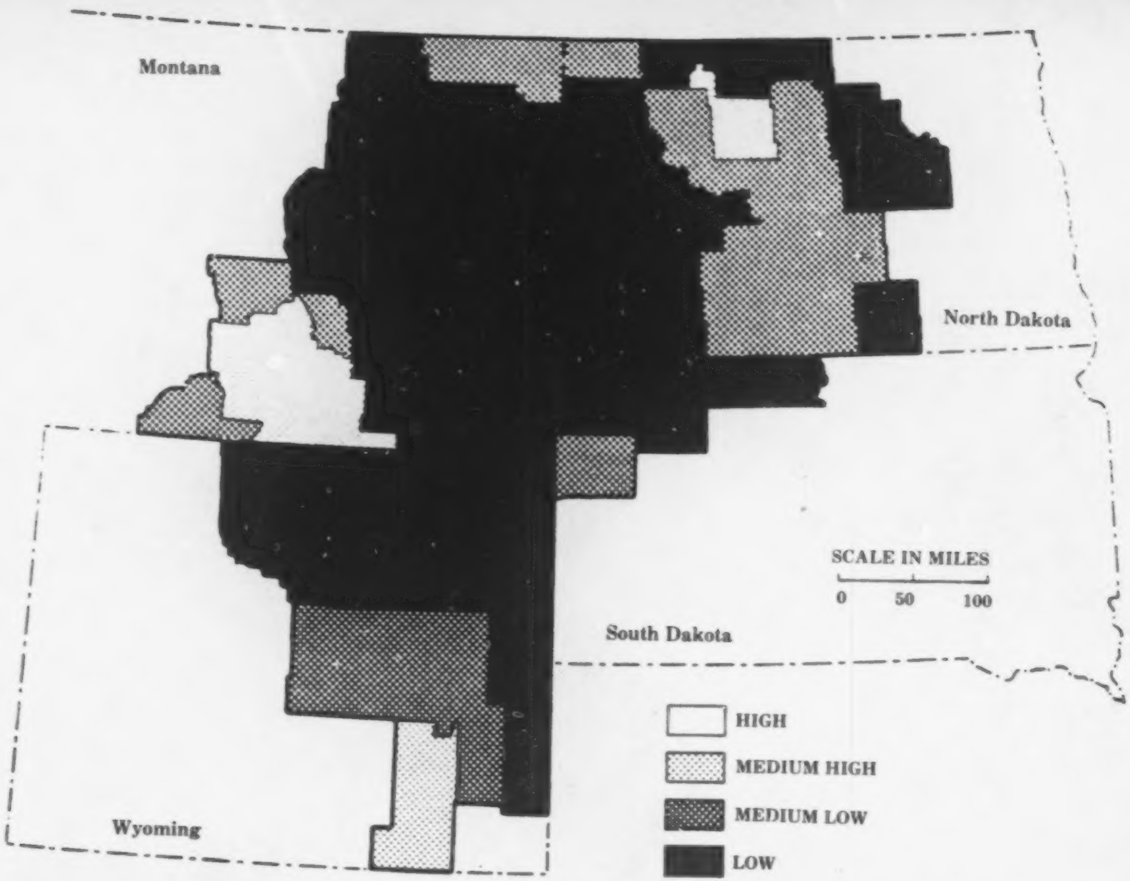

Montana
North Dakota
South Dakota
Wyoming
SCALE IN MILES
0
50
100
HIGH
MEDIUM HIGH
MEDIUM LOW
LOW

Figure 22. Relative Ease of Siting Based on Socioeconomic Capacity (Rocky Mountain Area)

Source: SRI, "Environmentally Based Siting Assessment for Synthetic Liquid Fuels Facilities," December 1979.

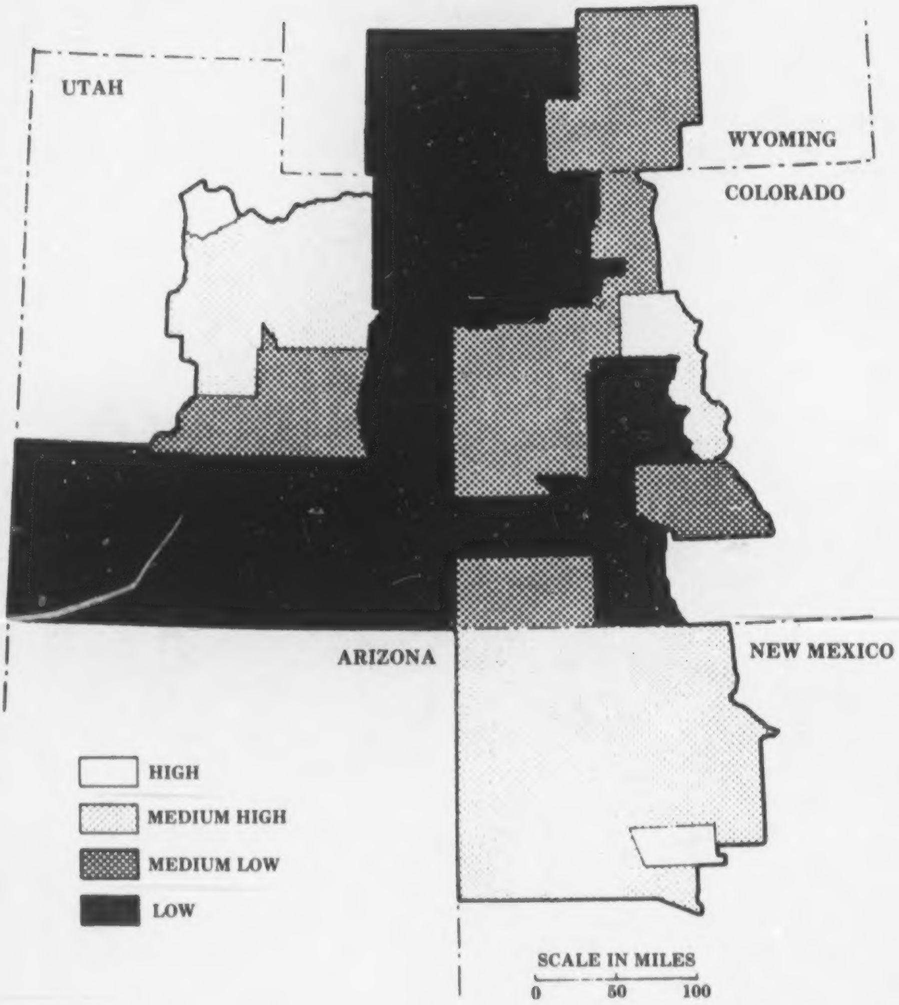

UTAH
WYOMING
COLORADO
ARIZONA
NEW MEXICO
HIGH
MEDIUM HIGH
MEDIUM LOW
LOW
SCALE IN MILES
0
50
100

Figure 23. Relative Ease of Siting Based on Socioeconomic Capacity (Four Corners Area)

Source: SRI, "Environmentally Based Siting Assessment for Synthetic Liquid Fuels Facilities," December 1979.

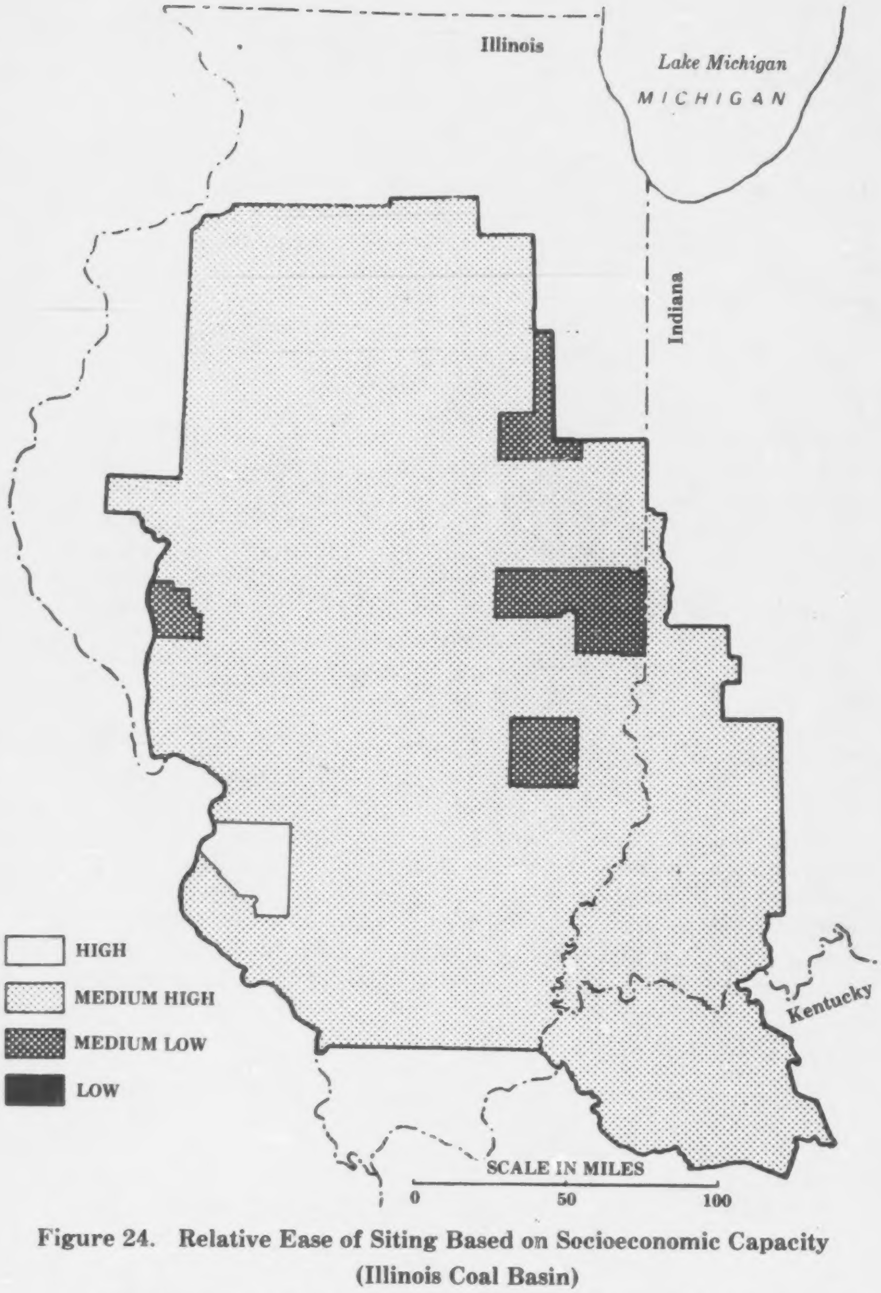

Illinois
Lake Michigan
MICHIGAN
Indiana
Kentucky
HIGH
MEDIUM HIGH
MEDIUM LOW
LOW
SCALE IN MILES
0
50
100

Figure 24. Relative Ease of Siting Based on Socioeconomic Capacity (Illinois Coal Basin)

Source: SRI, "Environmentally Based Siting Assessment for Synthetic Liquid Fuels Facilities," December 1979.

and infrastructure. The differences in absorption capacity which exist between regions are illustrated in Figures 22, 23 and 24. These figures indicate that the eastern U.S. may be more favorable for energy development than the western U.S. based on its greater capacity to absorb new growth.

Experience has also shown that rural communities are often poorly equipped to handle the consequences of rapid urbanization and industrialization. Existing facilities are severely strained and the social structure may be substantially altered. Indices of the consequences of such changes can include significantly higher rates of divorce, alcoholism, drug use, crime and mental disorders. The provision of public services lags behind the population influx for construction, largely due to the fact that local tax revenues lag behind the need for infrastructure (roads, water, sewer, police, fire, schools) development. The scheduling uncertainties of large energy development projects add to the difficulty in estimating these needs.

Drawing upon past experience, as well as the large body of literature in the social sciences on the process of urbanization and industrialization, it is clear that the problems of growth associated with energy development are far from intractable. Indeed, the severity of local community impacts can be mitigated or avoided altogether if socio-economic and other potential impact areas are taken into account at the early stages of energy development. At that point it is particularly important that local governments begin to develop strategies and programs to address growth management problems. To assist in this process, Kentucky DOE has put in place a population projection model for the area which will be periodically updated as new information is made available.

Population Changes

In this report the labor projections for the four synfuels plants are used to estimate the temporary population increases expected during construction and the permanent population increases expected during the operational phase. These population changes will drive all other socio-economic variables. In other words, the needs for housing, health care facilities, teachers, and so on can be projected and then compared with current capacities in the region. The communities or the region may have vacant housing units, excess health care capacity, or decreasing enrollment in the schools. On the other hand, new services or facilities could be required if the present capacity is less than adequate. In this report, population increases are used as a guide to indicate the magnitude of the changes in the facilities, services, and infrastructure that might be required due to the synfuels development. Later reports will deal in detail with the specific needs on a regional, county and community basis.

A model for projecting population changes accompanying the synthetic fuels development is being developed at the request of the KDOE and will be maintained and updated by the Urban Studies Center at the University of Louisville. The analysis covers the construction and operational phases and is broken down by county and age group. Its base is the most recent population figures for the counties (1980 preliminary census results). Additional population is determined by applying multipliers (to account for workers' families and secondary employment) to the employment figures for the synfuel plants and coal mining.

Preliminary Estimates

There will be considerable competition for skilled construction labor in the region. This competition will extend to the national level if synfuels development occurs as expected over the rest of the country. It is likely that a significant fraction of the local construction force could be utilized by the 10 power plant units planned for the region. Thus, a large portion of the peak force of 26,820 projected for 1985 could come from in-migration. Preliminary estimates indicate that if 25% of this peak force relocates in the region the resulting population increase could be 25,000; if 50% relocates the increase would be 50,000 and so on. The increase would not occur in just the three counties with synfuel projects (Henderson, Daviess, and Breckinridge) but would be spread over about a 30 to 90-minute commuting range from each site. Obviously, in-coming workers would be more concentrated in the 30-minute range than in the 90-minute range and the existing urban centers within the 30-minute range (Henderson, and Owensboro, Kentucky; Evansville and Tell City, Indiana) may be expected to absorb a large portion of the new growth.

The operating labor force for the synfuel plants is projected to be 7,000-8,000. A large portion of these workers will not be required in the high-skilled crafts and may be drawn from the local unemployed and job switching. Assuming that one-half to two-thirds of the jobs can be filled in this way (within a 60-minute commuting range), the resulting new population in 1990-91 would be 14,000-21,000. This new population may be compared with the 1990 projected populations for these counties (based on normal growth) to put this increase into perspective and to get some idea about where the increase will be distributed (Table 11).

The new coal mining workforce required to supply the synfuel plants may be larger than the operating labor force in 1990-91. The population increase may be estimated assuming 8,000 new miners, (one-third to two-thirds of which could come from in-migration). This leads to a population increase of 16,000-32,000 for the coal-producing counties and their neighbors. If only 50% of the coal for the synfuel plants comes from the western Kentucky coal fields, these counties would have about half of the above population increase. These increases may be compared to the population projections for these counties in Table 11.

Environmental Health Issues

An additional social issue which has been raised concerning the synfuels industry is the potential effects of plant operations on the health of workers in the plants and on residents

Table 11
Population Changes for the Synfuels Development: Operational Phase

County	1990 Population Projections*	1990 Population Increases Associated with Synfuels Development
Henderson	43,686	
Daviess	89,672	
Hancock	7,928	14,000-21,000 for plant operation
Breckinridge	17,593	
Vanderburgh, Ind.	168,772†	
Union	20,376	
Webster	17,548	
Muhlenberg	34,182	
Ohio	25,950	16,000 - 32,000 for mining
McLean	12,963	
Butler	11,410	
Grayson	23,058	

* Kentucky Department of Commerce, Kentucky Deskbook of Economic Statistics, 1979-80.

† 1970 population.

in nearby communities. In fact, there has been some speculation that since the synfuel plants in western Kentucky will be first-of-a-kind plants, the workers and local residents will be subjected to extraordinarily high risks from numerous, but largely unknown, sources. Much is known, however, about the potential effects of this industry on public and occupational health. This question will not be dealt with here, but is addressed in a separate report entitled "The Synthetic Fuels Industry in Kentucky: An Assessment of Environmental Health Issues" (Kentucky Department of Energy, February 1981). The report includes a discussion of the existing environmental standards and control requirements and some background is given to aid in understanding the nature of the health issues. The assessment also includes a number of things that can be done that will help ensure that the development of the synfuels industry occurs in an environmentally responsible manner.

IX. PHYSICAL ENVIRONMENT

The proposed synthetic fuels industry will be discussed from the standpoint of the effects it will have on the physical environment and natural resources, including coal and minerals, water, land, and air. Omitted from this section is a discussion of effects on ecosystems or public and occupational health. The latter will be dealt with in a separate series of reports. The determination of effects on ecosystems requires a detailed description of the existing conditions. This is not available on a regional basis at this time and would require considerable research and field work to establish. This will be done for each project in a highly detailed fashion as part of the Environmental Impact Statement process.

Coal Resources

The effect of the synfuel industry on coal resources was discussed previously in this report. Briefly, it appears that the resources in western Kentucky (39 billion tons) are sufficient to supply a sizeable synthetic fuels industry. The four proposed plants together will require 0.1% of this resource per year. This can be compared with the current production rate which accounts for 0.12% of the resource per year (1979 production). Thus, coal resources of the region are large yet finite. They appear to be capable of supplying the utility, industrial, and synthetic fuel markets during the transition period from fossil fuels to renewable energy sources.

Minerals and Other Resources

After coal, the major mineral resource required by synfuel plants is limestone. Most of the plants will use a coal-fired boiler to generate steam and electricity and the flue gas will require sulfur removal (flue gas desulfurization - FGD). FGD devices usually use limestone as a reagent. To achieve 90% sulfur removal for high-sulfur coal, about 0.1 tons of limestone is required for every ton of coal fired in a boiler. The four synfuel plants will require 2,000 tons/day of limestone.

There are abundant limestone deposits in western Kentucky as shown in Figure 25. The limestone of this region is typically found in very thick beds - up to 300-400 feet. To supply four synfuel plants from a 200-foot bed will require the mining of less than one acre per year.

The other major use of resources for the industry which can be identified at this time is that required for the plant construction materials. As an example, the requirements for the SRC-I demonstration plant are shown in Table 12. The major needs are for steel, copper (wiring), lumber, concrete, and asphalt.

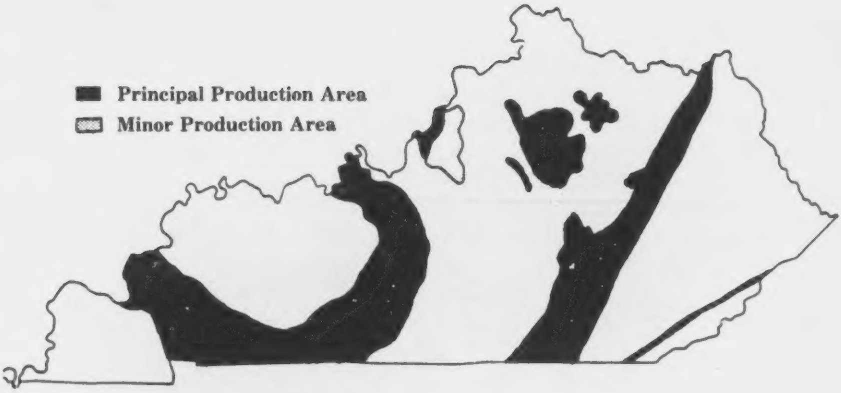


Figure 25. Limestone and Dolomite in Kentucky

Source: Kentucky Department of Commerce, "Total Resources Development," 1969.

Table 12
Materials of Construction for the 6,000 TPD SRC I Demonstration Plant

Material	Required for SRC I
Concrete (excluding architectural buildings)	71,000 yd^3
Reinforcing steel	3,700 tons
Structural steel (excluding architectural buildings)	3,900 tons
Asphalt	1,100,000 ft^2
Railroad trackage	63,000 ft
Bare pipe	3,400 tons
Glass	28,000 ft^2
Wood	1,750,000 board ft

Source: U.S. DOE, Draft Environmental Impact Statement, Solvent Refined Coal-I, January 1981.

Water Consumption

The water withdrawal rate for the four synfuel plants will be about 80 million gallons/day. Nearly all this demand will be consumed during cooling; very little return to the streams will occur from these facilities. One reason for the large consumption rates is the regulatory policy favoring evaporative cooling over once-through cooling. The latter resulted in some undesirable thermal discharges to streams and loss of fish through impingement and entrainment. However, the shift to evaporative cooling towers led to a three to four-fold increase in water consumption for cooling (Table 13). The water demands could be cut by nearly 50% through the use of advanced dry cooling technology; such conservation measures could add 5% to the product cost for most synfuel processes.

Table 13
Steam-Electric Plant Water Requirements by Fuel Type and Cooling Option *

Fuel Type	Cooling Option	Withdrawal† (MGD)	Consumption† (MGD)
Nuclear	Once through	1400	4
	Cooling pond or canal	42	26
	Wet cooling tower	28	17
	Dry cooling tower	0.3	0
Fossil‡	Once through	830	3
	Cooling pond or canal	25	15
	Wet cooling tower	17	10
	Dry cooling tower	0.2	0

* Plant capacity: 1000 MWe.

† These are national average rates. Zero discharge has not been assumed due to uncertainties as to how widespread its application may be.

‡ Flue gas desulfurization units add 1 MGD to withdrawal and consumption rates.

Source: J.E. Dobson, et al., *A Nationwide Assessment of Water Quantity Impacts of the National Energy Plan; Volume I: Summary and Conclusions*, ORNL/TM-6098, ORNL/OPEA-3, Oak Ridge National Laboratory, Oak Ridge, Tenn., December 1977.

Studies by Oak Ridge National Laboratory and the Ohio River Basin Commission have found that synfuels development will not cause any water availability problems due to siting along the Ohio River. However, problems could develop during low-flow conditions for plants sited along some of the Ohio River tributaries, including the Green River. Estimates of the low-flows for the Green River are shown in Table 14. The U.S. Army Corps of Engineers regulates the flow on the Green River through a series of locks and dams and reservoirs; the flow is maintained to ensure channel depths of 9 feet for barge transportation up to mile 103 in Butler County. This places a limit on how much of the low-flow is available for consumption, as do prior claims on withdrawals by public and private users. Based on the above, it would be difficult to site a synfuel plant where it would consume more than about 10% of the low-flow of the Green River or above mile 100 near Paradise in Muhlenberg County. The two synfuel plants proposed near the mouth of the Green River together will require about 35 million gallons of water per day (Table 15). This is 16% of the critical low-flow (21% when the proposed new power plant is included). In this case water conservation measures (including water storage and dry cooling) will have to be considered. However, since the W.R. Grace project is located below the first lock on the Green River, this plant may in effect be withdrawing from the Ohio River pool.

Table 14
Low-Flow Data for the Green River

Location	County	River Mile	7-Day, 10-Year Low-Flow (MGD)
Ohio River	Henderson	0	255
Calhoun	McLean	63	251
Paradise	Muhlenberg	100	218
Woodbury	Butler	149	215
Brownsville	Edmonson	182	135

MGD — million gallons per day.

Source: KDNREP, "The River Basin Water Quality Management Plan for Kentucky, Green River," 1975.

Table 15
Effect of Synfuel Plant Water Consumption on Critical Surface Water Flow

Project	River	7-Day, 10-Year Low-Flow (MGD)*	Synfuel Plant Consumption (MGD)*	Cumulative % of Low-Flow†
SRC I	Green	255	17	7 (8)
W.R. Grace	Green	255	23	16 (21)
H-Coal	Ohio	9,300	12	0.1 (0.1)
Tri-State	Ohio	9,700	23	0.4 (0.8)

* MGD - millions of gallons per day.

† Values in parenthesis include new power plant water consumption.

Water Quality

In addition to water consumption, the effect of the synfuels plants on water quality must also be considered. The water quality concerns of the coal conversion facility will probably be less than those for the associated coal mining or even the additional municipal waste treatment discharges which results from the population increase.

The untreated water from coal conversion processes will contain a number of toxic materials. The water treatment facilities will reduce the concentration of these substances to meet all current water quality standards. Waste water treatment at existing pilot facilities is meeting current standards. The ultimate goal of the Clean Water Act of 1972 is to eliminate industrial discharges to streams entirely by 1985, i.e., zero discharge. To eliminate discharges all waste water will be recycled with evaporative ponding of ultimate wastes or with recovery of solids and landfilling. The environmental effects of this option should be less in most cases. All four synfuel projects are considering the zero discharge option.

Synfuel plants can also have an indirect effect on water quality due to consumption of receiving waters. The large volume of flow in streams acts as a diluent for the concentrated wastes that enter the water from point (municipal and industrial) and nonpoint (agriculture and mining) sources. Significant decreases in stream volumes could increase the frequency and severity of water quality standard violations. The two plants planned on the Ohio River will each use less than 0.2% of the low-flow and will not cause a significant decrease in stream volume. The 16% of the Green River low-flow consumed by the W.R. Grace and SRC-I plants could be significant and will require further investigation.

Coal mining has been a major cause of water quality degradation in Kentucky, primarily by the sediment from surface mines, erosion of spoil banks from mining and coal cleaning, and the acidity and high iron and manganese concentrations in mine drainage. Areas of western Kentucky affected by acid drainage are shown in Figure 26. Requirements for mining and reclamation under the Surface Mining Control and Reclamation Act and the New Source Performance Standards under the Clean Water Act will require a high degree of control of sedimentation, iron, and acidity from mine effluents and run-off. This should result in a reduction in the water quality violations experienced in the Green River in the coal producing areas and prevent new mining operations from contributing to new violations.

The greatest cause of water quality violations is the discharge of improperly treated human sewage and urban run-off. Therefore, it is most important that new urban developments in west Kentucky be accompanied by adequate sewage treatment facilities to accomodate the population growth. This can be accomplished by expansion of the existing system or by the construction of additional, separate systems. In either case it will create an opportunity for communities to upgrade and bring existing systems into compliance with the 1972 Federal Water Pollution Control Act (only 40% of the major municipal discharges were in compliance by the 1977 deadline).

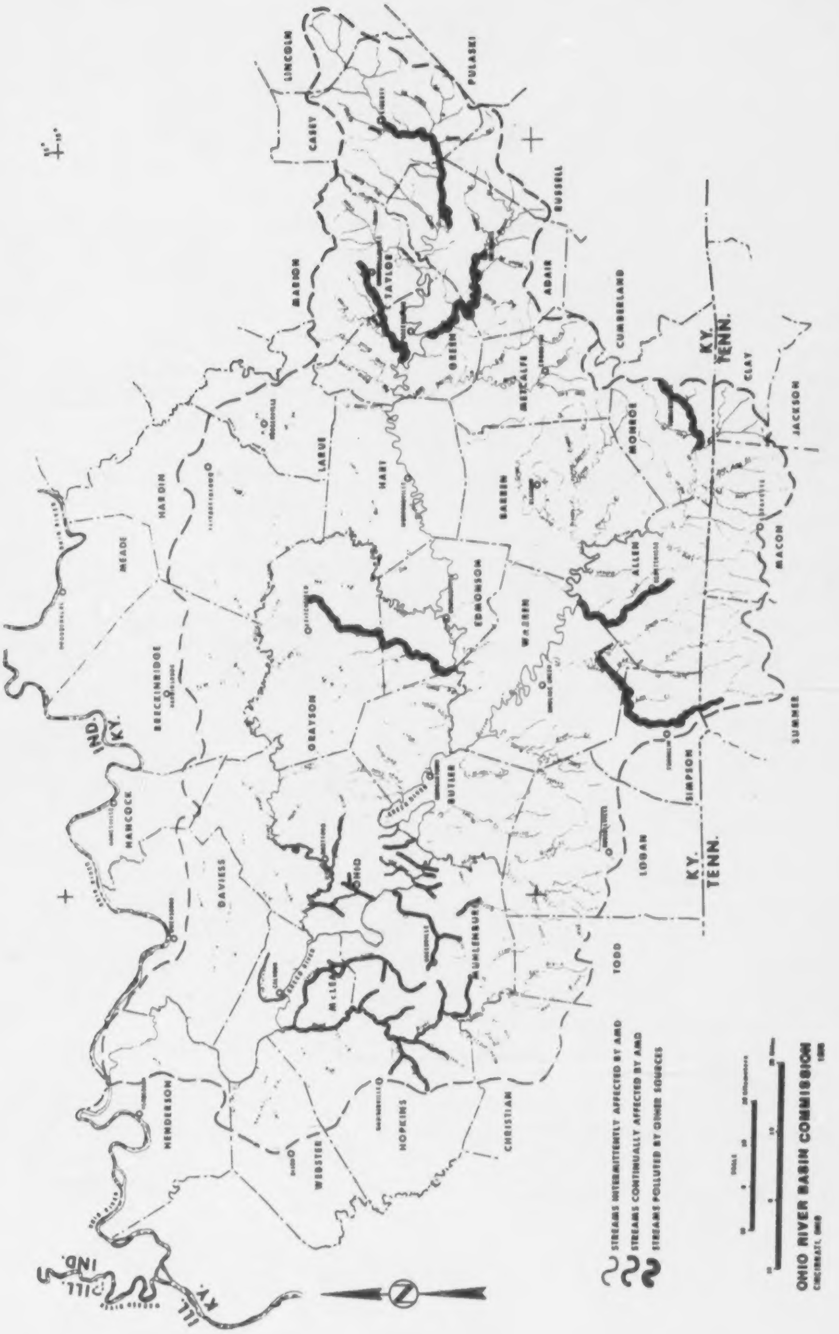

KY.
IND.
ILL.
HENDERSON
WEBSTER
HOPKINS
CHRISTIAN
DAVIESS
McLEAN
MUHLENBURG
OHIO
TODD
HANCOCK
BRECKINRIDGE
GRAYSON
BUTLER
LOGAN
KY.
TENN.
MEADE
HARDIN
LARUE
HART
EDMONSON
WARREN
SIMPSON
SUMNER
ALLEN
MACON
BARREN
MONROE
JACKSON
CLAY
METCALFE
CUMBERLAND
KY.
TENN.
GREEN
ADAIR
TAYLOR
MARION
RUSSELL
CASEY
LINCOLN
PULASKI
GREEN RIVER
OHIO RIVER
STREAMS INTERMITTENTLY AFFECTED BY AMD
STREAMS CONTINUALLY AFFECTED BY AMD
STREAMS POLLUTED BY OTHER SOURCES
SCALE
OHIO RIVER BASIN COMMISSION
CINCINNATI, OHIO
N

Figure 26. Areas of Acid Mine Drainage (Green River Basin)

Of increasing concern in the U.S. is the quality of ground water resources. About half of the population and 95% of the rural population relies on ground water for drinking water and other domestic uses. Ground water is generally found in water-bearing geological formations known as aquifers. Water moves through these formations at very slow rates and, in some cases, over great distances. The natural high quality of ground water is due to the enormous capacity of the upper layers of soil to decompose, bind and filter out contaminants.

Although nationwide the quality of ground water is good, numerous cases of contamination, including drinking water supplies, have been detected. To some extent this has been a result of our efforts to control air and surface water pollution: the pollutants which formerly ended up in those media are now being put underground. Seepage from existing open dumps, unlined sanitary land fills, and industrial waste ponds present the major potentials for pollution; other sources include contamination from agriculture, mine tailings and mine drainage, road salt and septic tanks. Wells in West Kentucky have been affected by leachate from septic tanks and mine drainage.

It may take several decades to locate and clean up the major dump sites contributing to ground water pollution. Congress has passed legislation creating a "superfund" to finance this effort (using industry contributions). This problem will be controlled in the future by the Resource Conservation and Recovery Act of 1976, which makes it a criminal offense to dispose of any hazardous material except at specially permitted facilities. These facilities will have to meet stringent standards to prevent seepage of any toxic material into ground (or surface) water. The other major provision of this law makes the generator of the waste ultimately responsible for its disposal. The disposal standards should ensure that any solid waste materials generated in synfuel plants will be treated, recycled, or disposed of in secure landfills, taking all the necessary precautions to protect ground water.

Air Quality

Clean air is another of our precious resources and the 1970 Clean Air Act and the amendments of 1977 stated this country's commitment to protect and enhance air quality. As a result, the state's air quality has been improving. The Clean Air Act directed that standards be set for those air pollutants which pose a threat to human health (primary standards) or welfare (secondary standards). Thus far, standards have been adopted for sulfur dioxide, particulate matter, nitrogen oxides, carbon monoxide, photochemical oxidants and hydrocarbons, and lead (see Table 16).

The state has undertaken a major air monitoring effort to determine where these standards are being violated (see Table 17 for the designated nonattainment areas of Kentucky). The air quality in the western Kentucky region is generally good, however, there are several areas near the synfuel plant locations where standards are not being met for particulate matter

Table 16
National Primary and Secondary Ambient Air Quality Standards

Pollutant	Type of Standard	Averaging Time	Frequency Parameter	Concentration	
				μg/m³	ppm
Carbon monoxide	Primary and secondary	1 hr	Annual maximum*	40,000	35.00
		8 hr	Annual maximum	10,000	9.00
Hydrocarbons (non-methane)	Primary and secondary	3 hr (6 to 9 a.m.)	Annual maximum	160†	0.24†
Nitrogen dioxide	Primary and secondary	1 yr	Arithmetic mean	100	0.05
Particulate matter	Primary	24 hr	Annual maximum*	260	—
		1 yr	Geometric mean	75	—
	Secondary	24 hr	Annual maximum*	150	—
		1 yr	Arithmetic mean	60**	—
Sulfur dioxide	Primary	24 hr	Annual maximum*	365	0.14
		1 yr	Arithmetic mean	80	0.03
	Secondary	3 hr	Annual maximum	1,300	0.50
Lead	Primary	90 day		1.5	—
Ozone	Primary and secondary	1 hr	Annual maximum*	235	0.12

* Not to be exceeded more than once per year.

† As a guide in devising implementation plans for achieving oxidant standards.

‡ Expressed as ozone by the Federal Reference Method.

** As a guide to be used in assessing implementation plans for achieving the annual maximum 24-hour standard.

(the cities of Henderson, Owensboro and Evansville, Indiana). The problems in the region are largely due to nontraditional sources of particulates rather than industrial or point source emissions. Such sources include dust, soil and minerals from unpaved roads, agricultural and mining operations and the stirring (or re-entrainment) of dust on city streets and highways. These same areas have experienced problems in the past with photochemical oxidants (measured as ozone). The states are responsible for ensuring that control measures are taken to bring these areas into attainment of the standards by 1982. Kentucky has submitted to the U.S. EPA its plan for bringing all of its nonattainment areas into compliance including those in western Kentucky. Several of the areas designated as nonattainment in 1978 have already been reclassified as attainment. The law also prohibits the construction of new industries whose emissions will affect a nonattainment area, except in cases where an offset, or emission reduction, equal to the new emissions can be found.

Table 17
Designated Air Quality Non-attainment Areas in Kentucky

Total Suspended Particulate

Bell County
Boyd County
Shepherdsville
Newport
Owensboro
Henderson
Jefferson County
McCracken County
Marshall County
Muhlenberg County
Hazard
Pikeville
Corbin
Louisa
Richmond

Sulfur Dioxide

Southern Boyd County
Jefferson County
McCracken County
Webster County
Muhlenberg County

Carbon Monoxide

Jefferson County

Ozone

Boone County
Boyd County
Campbell County
Fayette County
Jefferson County
Kenton County

Source: KDNREP, "Proposed Regulations of the Kentucky Division of Air Pollution Control," 401 KAR 51:010, Attainment Status Designations, December 1980.

In areas where the air quality is better than the standards new sources of emissions can be allowed only under certain conditions. One condition is that the facility must be able to demonstrate that its emissions will not cause the air quality standards to be violated. Furthermore, the facility must use the "best available control technology" for controlling its air emissions. For most industries there are also "new source performance standards" which establish the amount of emission reduction required and the maximum allowable emission limits. Finally, for sulfur dioxide and particulate matter only an incremental increase in ambient air levels above the level that existed in 1975 will be allowed. This increment in western Kentucky (defined as a Class II area) is about 25% of the standards. Thus, the maximum levels allowed in the air can be estimated as follows:

sulfur dioxide increment:	**20 μg/m^3**
sulfur dioxide levels in Daviess County in 1975:	**9-22 μg/m^3**
	29-42 μg/m^3
sulfur dioxide ambient air standard (annual average):	**80 μg/m^3**

By this example, it can be seen that the maximum allowable levels of sulfur dioxide in Daviess County may not exceed 29-42 μ g/m^3, which is well below the primary standard (the level set to protect public health). This level becomes, in effect, a new primary standard for the county. The annual average sulfur dioxide levels in Daviess County for the year ending in September 1980 ranged from 21-24 μg/m^3.

All these specific control technologies, emission reductions and limits, and ambient air limits become part of a plant's permit conditions. When operation begins, compliance must be demonstrated by performance tests, including in many cases continuous monitoring of individual stacks. Ambient air monitoring is also required to ensure that standards and increments are not exceeded. When permit conditions cannot be met additional control measures must be adopted.

The effects of synfuel plants on air quality will be very site specific. In general, the levels of any air pollutants will be greatest very near the plants - within 1-2 miles - and at points beyond 10-15 miles, the plants will make no significant contribution to air levels. The effect of each individual plant will be determined as part of the application for air permits. The effects of the synfuel industry (the four proposed plants) plus the power plants and all other existing and proposed industrial sources will be determined by the Kentucky DOE as part of the synfuel industry assessment. Such an analysis is needed to determine whether the region has enough clean air space to accomodate the synfuel plants, whether future growth will be compromised, whether more emission controls are needed and whether alternative sites should be considered.

Some preliminary estimates can be made for the total regional emissions loadings due to the synfuels industry. In Table 18 these emissions are compared to the 1976 total regional emissions and the proposed new power plant emissions. The synfuel plants will cause only a small increase (8%) in particulate emissions. Increases in hydrocarbons (25%) and nitrogen oxides (130%) may be significant since both contribute to oxidant formation. These are a problem largely of urban areas, where automobiles are the predominant source. Control of this problem is prescribed in the Clean Air Act through the requirements for major reductions in the allowable levels of nitrogen oxide and hydrocarbon emissions from new cars. Thus, violations of the ozone standard should no longer occur after the existing fleet of automobiles is replaced by the 1980-82 and later models which incorporate the additional controls. To ensure that this air quality improvement will be achieved, the effect of synfuel plant emissions on future ozone levels needs to be examined.

Table 18
Effect of Synfuel Plants on Air Emissions in the Evansville-Owensboro-Henderson Air Quality Control Region*

Emission Sources	Thousands of Tons/Year				
	SO_2	TSP‡	NO_2	CO	HC‡
1976 - Point Emissions†	263	34	42	88	8
-Area Emissions†	3	16	15	12	21
-Total†	**266**	**50**	**57**	**100**	**29**
1976 - 1992 New Power Plants	267	20	180	11	3
Four Proposed Synfuel Plants	50	4	74	15	7

* Includes Kentucky counties: Daviess, Hancock, Henderson, McLean, Ohio, Union, Webster and Indiana counties: Dubois, Gibson, Perry, Pike, Posey, Spencer, Vanderburgh, Warrick.

† EPA, *1976 National Emissions Report*, August 1979.

‡ TSP, total suspended particulate; HC, hydrocarbons.

The sulfur and nitrogen oxide emissions of synfuel plants and new power plants will be a significant increase over 1976 levels. The standards are not likely to be endangered, however, as the present concentrations of these two pollutants are very low in western Kentucky, in spite of the large amount of high-sulfur coal used there. The resulting increases in sulfate levels will contribute somewhat to the episodic visibility problems of the region. Sulfur and nitrogen emissions are also increasingly coming under attack, whether warranted or not, as contributing to interstate pollution and acid precipitation.

The increased mining activity will add to the levels of particulate emissions, although quantification is difficult. In the mining region one county, Muhlenberg, is not meeting the particulate air quality standards and the problem has been partially attributed to present surface mining operations. The new population growth will contribute to air pollution mainly through the greater use of automobiles and will impend on an already borderline problem.

Land Use

Synfuel facilities will require 1,000-2,000 acres of land (Table 19), which should be relatively level and near a major waterway. In western Kentucky such land is usually classified as agricultural and each of the four sites has a significant acreage of farmland. The amount of farmland taken countywide will be rather insignificant in each case and may be more than offset by future increases in agricultural productivity.

Table 19
Synfuel Plant Land Use by County

	Tri-State	W.R. Grace	SRC I	H-Coal
Plant Site (acres)	2,000	1,500	1,500	1,000
County	Henderson		Daviess	Breckinridge
County Area (acres)	277,295		295,577	354,766
County Cropland (acres)	167,784		173,443	167,864
% of Area Used	1.3		0.5	0.3
% of Cropland Used (max)	2.1		0.9	0.6

Prime farmland is one of our most valuable natural resources. West Kentucky is a major agricultural area and has a large share of the state's prime farmlands (Figure 27). Every effort is needed to protect this resource by good agricultural practices, erosion controls, and the prevention of indiscriminant industrial development. Contrary to many widely held views and in spite of the enormous growth in population and development, the major land uses in the U.S. have not changed significantly in the last 75 years (Figure 28). Furthermore, urban sprawl has contributed to the greatest use of agricultural land, much more so than industrial development. Finally, it should be noted that an absolute protection of farmland would probably bring to an end nearly all industrial, commercial, and residential growth in many areas of western Kentucky.

Solid waste disposal will require additional acreage, but will not involve farmland, if at all possible. A 20,000 ton/day synfuel plant will produce approximately 3,000 tons/day of solid waste or about 500 acre-feet/year. Assuming a storage depth of 50 feet, the four plants would require 56 acres per year. This land could be returned to productive use.

The mining of additional coal for the synfuel plants will result in significant land disturbance. An estimate for 40 million tons of coal with 50% from surface mining is 4,000 acres disturbed per year (based on 1800 tons of coal/acre-foot, 45 inch seams, and 80% recovery and adding 10% for additional disturbances; haul roads, prep plants, etc.). Some of the coal

Table 20
Land Use Comparisons for Synfuels: Coal vs Corn

260,000 BOE/Day Coal Conversion Industry

4 Plants	6,000 Acres
Waste Disposal	56 Acres/Year
Coal Mining	4,000 Acres/Year
Urban Areas	7-13,000 Acres

260,000 BOE/Day Ethanol from Corn

295 Plants*	15-30,000 Acres
Corn Production†	24,000,000 Acres/Year

*20 Million Gallons/Year; 50-100 Acres/Plant
†2.5 Gallons/Bushel; 100 Bushels/Acre

is under agricultural lands. The new surface mining laws will not allow farmland to be disturbed unless it can be returned to equal quality for its original use.

The population growth may contribute to some urban sprawl and this will require land. The estimates for the maximum additional urban areas needed in 1990-92 are: 3,300-5,000 acres resulting from plant operation and 3,800-7,600 acres resulting from coal mining (based on 2,682 persons/square mile in Kentucky urban-suburban areas). A summary of the land use for a 260,000 barrels of oil equivalent/day coal conversion industry is shown in Table 20.

The land needs may seem high but need to be compared against an alternative source of energy to gain perspective. For the production of liquid fuels, one could consider a renewable source: ethanol from corn, which is also being promoted in Kentucky. To produce the equivalent amount of energy would require almost 300 commercial ethanol plants, which would use more land than the coal conversion plants (assuming 20 million gallon/year plants and 50-100 acres/plant).

This would result in one plant in every 132 square miles of Kentucky or one plant every 12 miles throughout the state. In contrast to the coal resource, which could be produced in several counties of western Kentucky the area needed for corn production would be staggering (assuming 2.5 gallons/bushel and 100 bushels/acre): 24,000,000 acres/year. This acreage is not available in Kentucky – the entire state is only 25,500,000 acres. In fact, the 2.4 billion bushels of corn required is about 40% of the total U.S. corn production.

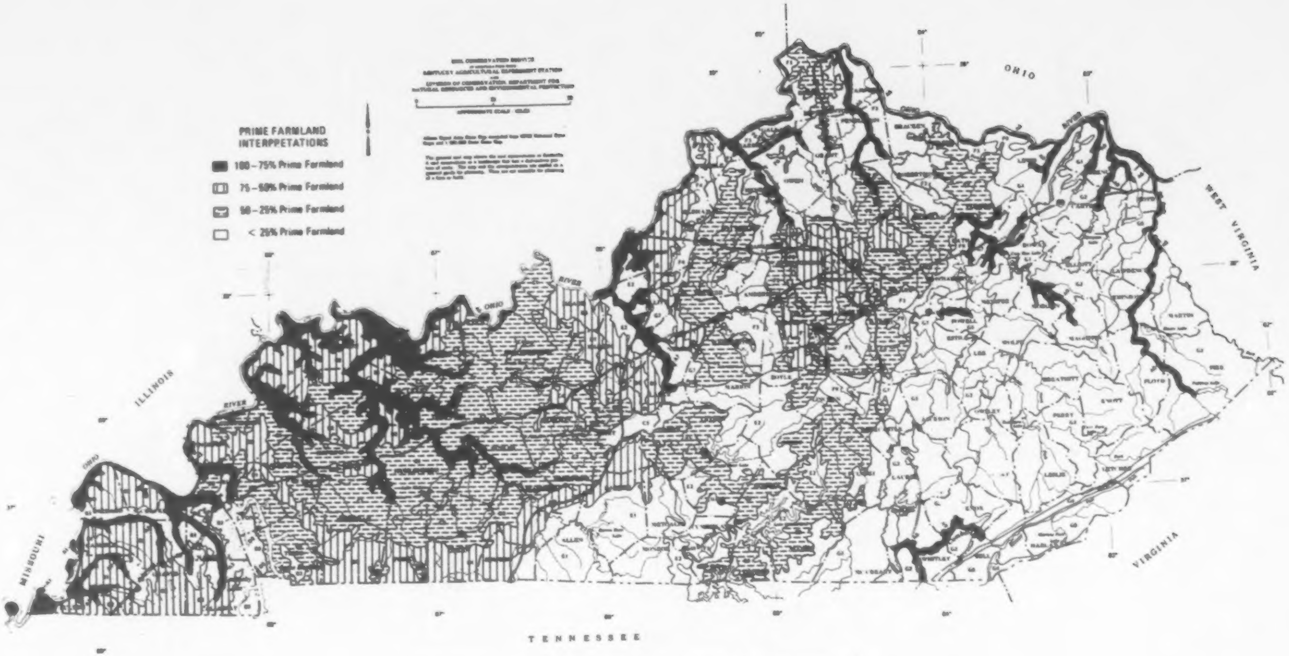

PRIME FARMLAND
INTERPPETATIONS
■ 100 – 75% Prime Farmland
▥ 75 – 50% Prime Farmland
▨ 50 – 25% Prime Farmland
☐ < 25% Prime Farmland
OHIO
WEST VIRGINIA
VIRGINIA
TENNESSEE
MISSOURI
ILLINOIS
OHIO
RIVER
OHIO
RIVER

Figure 27. Prime Farmland in Kentucky

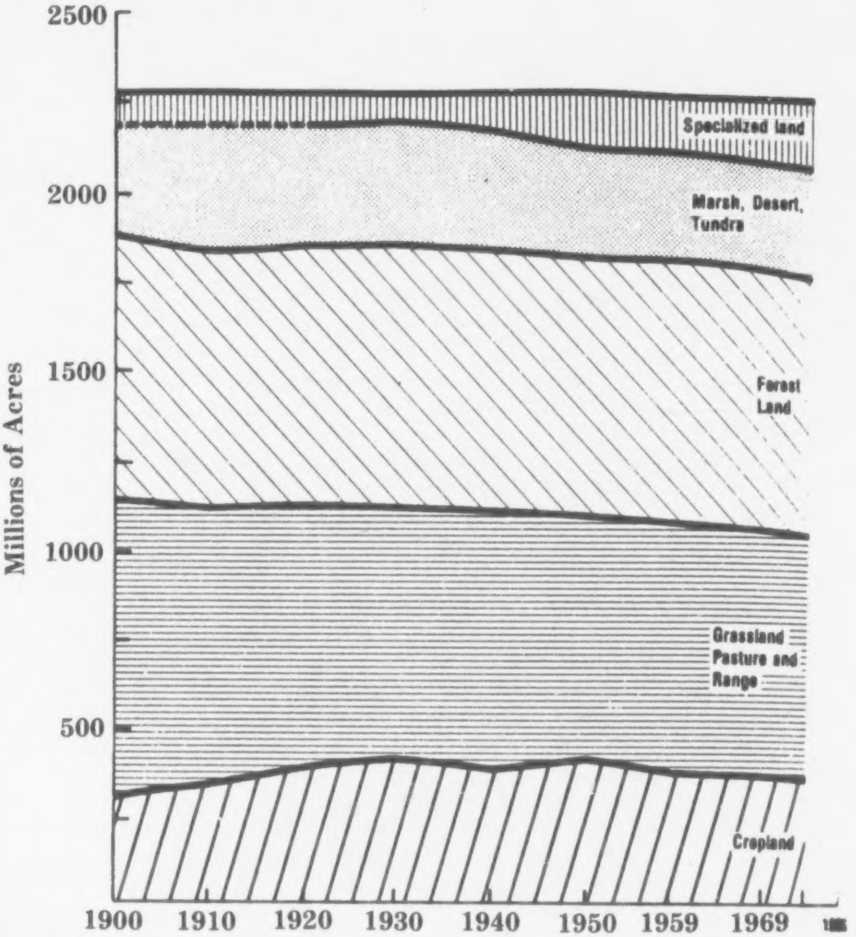


Figure 28. Major Uses of Land in the United States, 1900-74

Source: *Environmental Quality — 1979, The Tenth Annual Report of the Council on Environmental Quality,* USGPO, Washington, D.C., December 1979.

Note: *Forest Land* excludes reserved forest land in parks, wildlife refuges, and other special-use areas. *Specialized Land* is urban and built-up areas (including cities and towns, rural highway and road rights-of-way, railroads, airports, and public institutions in rural areas) and nonurban special-use areas (including Federal and State parks and other rural parks, recreational areas, Federal and State wildlife refuges, national defense sites, flood-control areas, Federal industrial areas, farmsteads, and farm roads).

X. CURRENT AND FUTURE PLANNING

Current Socio-Economic Planning

The preceding analysis (in Chapter VIII and elsewhere) indicates that the population increases could be significant during both the construction and operational phases of development. Major planning activities will be needed in many areas to accomodate this growth in an orderly manner. Numerous impact assessment studies are in progress to determine the social and economic effects of synfuels development in western Kentucky (Table 21). Planning efforts are underway at the State, regional, and local levels to determine the needs of the existing communities to meet these changes. The Green River Area Development District (GRADD) has undertaken a two-year $400,000 effort funded by U.S. DOE, to define and analyze the probable socio-economic impacts of the synfuel industry within the boundaries of the District (i.e., Daviess, Hancock, Henderson, McLean, Ohio, Union, and Webster counties). The project will involve a description of probable impacts indicating where, when, and upon whose shoulders the burden will fall. In addition, it will attempt to prepare local governments within the District to address such impacts. With regard to the latter, it is anticipated that an effort to involve local elected officials, the board of directors of GRADD, state and federal agencies, project proposers, and the general public will foster cooperation and provide the necessary communications network for the conveyance of information.

There are state and federal funds available for assistance to aid communities to prepare for new growth (Table 22). The first line of assistance in assessing need and sources of aid is the Area Development District. The table lists the agencies and types of aid that are applicable. It is important to remember that many of these programs have eligibility, planning or pre-application requirements that may call for lead times of a year or more before funds become available. The Area Development Districts are familiar with these.

The matrix presented here is not inclusive of all of the programs that may apply to a given need. It does cover the major program areas. It should also be noted that only one program, called Section 601 Energy Impact Assistance, is specifically limited to coal impacted counties in Kentucky. The rest can be used by any local government meeting the eligibility criteria. Federal funds are often allocated to Kentucky under various formulae and are often administered through a state agency.

Coordination and Future Planning

As previously stated, the intent of this document is to stimulate and provide an information basis for planning by governmental agencies. The responsibility for providing for adequate transportation, for protecting the environment and natural resources, for public protection and housing, for education and labor and other services exists in the charters of various state agencies. The units charged with those responsibilities will respond with their own planning

Table 21
Synfuel Socio-economic Studies

1. Green River ADD Energy Impact Planning
2. Henderson City Planner
3. Owensboro City Planner
4. SRC-I Project Socio-economic Study (Dames and Moore)
5. Breckinridge Project (Watkins and Associates)
6. Lincoln Trails ADD Housing Study
7. KDOE Synfuel Industry Assessment
8. University of Louisville Urban Studies Center Population Projections
9. KDOT Transportation Study

Source: KDOE.

effort for the developing synfuel industry and indeed several such efforts are currently underway. On the state level executive coordination and policy making regarding the synfuel industry is occurring through the Synfuel Coordination Committee which is made up of the Governor's Cabinet. That group has met on several occasions.

Working under and in support of that Committee is a Synfuel Technical Committee which consists of representatives appointed by each Cabinet Secretary. This group has also met and will work closely in the future. As the biennial budget cycle approaches, the various departments will be developing a more detailed analysis of the synfuel industry, identifying priority issues, developing mitigation plans, and determining the support needed for planning and implementing mitigating measures.

The Kentucky DOE will continue to play a coordinating role in these activities. A detailed questionnaire has been sent out to the project developers. This will provide more detailed data regarding each project - labor requirements, resource requirements, products, schedules, environmental emission, and so forth. The labor construction requirement model will continue to be refined and more detailed data regarding the permanent operating force developed. The economic impacts of the industry, specifically the schedule of revenues, taxes and multipliers affected, are being studied in greater detail.

A regional air quality analysis is being carried out. This will allow a determination of the effects which can be anticipated due to the synfuel industry. The analysis will include the proposed new power plants and industries as well as all existing sources. Baseline regional health studies will also be carried out.

Finally longer range issues associated with the synfuel industry, particularly the potential for and the nature of downstream and spin off development, will be examined.

Table 22
Applicable Federal and State Programs for Impact Mitigation

FEDERAL	HOUSING	MASS TRANSIT	WATER	SEWER	ROADS	HEALTH	SCHOOLS	RECREATION
Farmers Home Administration (FmHA)	(a) Sec. 111 Rural Planning Assistance (b) "601" Energy Impact Assistance for growth planning and land acquisition/site development grants & subdivision plans.		"601" Public Facilities — 75% for lines & connections, 100% planning grants. FmHA also has other loans & grants for water & sewer treatment & lines.		"601" may fund access roads.		"601" may fund plans.	"601" may fund plans.
Housing & Urban Development (HUD)	Loan guarantees for mobile home parks & Section 8 & single family subsidies.							
Environmental Protection Agency				Sewer Treatment Plant & main lines funding known as "201"				
Department of Transportation		Carpool & vanpool funding & small rural public transit program. (Section 18)			If not in a metropolitan planning organization, then state agency programs Federal aid.			
Health & Human Resources						Formula grants to states for public health services and emergency medical services.		

STATE	HOUSING	MASS TRANSIT	WATER	SEWER	ROADS	HEALTH	SCHOOLS	RECREATION
Department of Education							Minimum Foundation, Power Equalization & School Building Assistance Authority.	
Department for Community & Regional Affairs	Develops state investment strategy to prioritize local "601" plan or grant requests for the designated impact areas which are the state's coal producing counties including the 15 in western Kentucky.							Administers outdoor recreation funding under Dept. of Interior, Heritage Conservation and Recreation Service.
Department for Natural Resources and Environmental Protection				Develops 5 yr. priority list for "201" planning, engineering & construction grants.				
Department for Human Resources						Administers formula funds under state health planning and certificate of need processes.		
Department for Transportation		Administers Section 18 formula grant to states & carpool, vanpool funding.			Plans & programs Federal aid formula grants for primary, secondary, and urban system roads with local officials.			
Bonding Authority		Local government can use KRS 103.200-103.2451 (Industrial Revenue Bonds)	KRS 103.200 - 103.2451.	Ky. Pollution Abatement Authority		KRS 103.200 - 103.2451.		KRS 103.200 - 103.2451.

THE
SYNTHETIC FUELS INDUSTRY IN KENTUCKY

An Assessment of Socioeconomic Issues

KENTUCKY DEPARTMENT OF ENERGY

THE SYNTHETIC FUELS INDUSTRY IN KENTUCKY

An Assessment of Socioeconomic Issues

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September, 1981

Technology Assessment Division
Bureau of Energy Research
Kentucky Department of Energy
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EXECUTIVE SUMMARY

The purpose of this report is to describe the existing socio-economic characteristics of an eleven county synfuel impact region and to identify the major issues raised by energy development. A summary of selected findings include:

Agriculture contributes significantly to the income of the region but very little to direct employment. It is the major source of income to Breckinridge, McLean, Meade and Webster but several other counties exceed these four in cash receipts.

A 5% growth in employment for both manufacturing and mining from 1976 to 1979 is indicative of the effect of national economic conditions on the region. Several counties lost manufacturing jobs.

Also evident since 1976 is the growth in labor force participation and in employment in the service industry which now exceeds manufacturing in each county except for Hancock and Henderson. In these 2 counties and Daviess manufacturing is the principle source of wage income, while mining is the principle source in Hopkins, Muhlenberg, Ohio and Union.

These economic base differences are also reflected in population trends. The major coal producing counties exceeded the state average of 13.7% population growth in the last decade.

A higher percentage of individuals and families with incomes below the poverty level in the 11 counties were found in counties with an agricultural orientation, less economic diversification and an aging population.

Conversion of land from rural to urban uses has occurred much more rapidly in the 70s than in the 60s. Comprehensive land use plans are in place in many of the counties and cities but zoning and subdivision regulation is not as widely developed.

Small independent school districts provide more local support for schools than most of the county wide systems. School enrollment is declining throughout the region.

Population changes projected according to current synfuel and power plant construction schedules will peak between 1984 and 1986. Counties estimated to have over 20% growth between 1980-1986 are Breckinridge, Hancock, Henderson and McLean.

Housing the population influx will be a major concern and could lead to urban sprawl, inflated rents and widespread use of mobile homes.

Estimations of public service costs and needs will require making judgements on housing choices of the construction workforce.

The number of relocators and weekly commuters will be most affected by the craft skill shortages in pipefitters, insulators, millwrights and boilermakers.

City and county land use controls will be the major determinant of the degree to which land will shift into urban uses because of population growth.

Expanded coal production may have a major effect on prime farmland in Muhlenberg and Hopkins County.

Growth in mining employment should not cause undue strain in the major coal producing counties.

INTRODUCTION

This report is part of the assessment of the Kentucky synfuel industry by the Technology Assessment Division of the Kentucky Department of Energy. It is a supplement to the publication, *The Kentucky Synfuel Industry: A Basis for Assessment and Planning.* That first report described the nature of the coal conversion processes proposed by the four projects and their potential impact on physical systems - air, water and land. It described the scale of the construction labor and coal demand and emphasized the uncertainties associated with the scheduling and financing of the projects. A second report* described the known health risks associated with coal conversion, the current control technologies, and the risk factors needing further research.

This report attempts to expand and refine the assessment of potential socioeconomic impacts that could result from construction of the four plants. It outlines the existing characteristics of the affected counties to show the setting in which the changes would occur. These characteristics form the context for many of the problems that construction may pose to the existing governmental, social and economic structure and relationships.

The counties immediately affected include Henderson, site of two projects; Daviess, adjoining Henderson and site of one project, and Breckinridge, approximately 65 miles east of Daviess and site of one project.

Henderson and Daviess are part of the Green River Area Development District (GRADD), a seven county region already defined as having a significant level of economic and social inter-relationships. The additional five counties, Union, Ohio, McLean, Webster and Hancock, were therefore included as part of the area to be described. Two counties adjoining the GRADD, Hopkins and Muhlenberg, were included as major coal producers which could experience large increases in coal production and also have economic ties to GRADD counties and are within daily commuting range of one or more of the sites.

Breckinridge County borders GRADD to the east. Its neighbor, Meade County, was included because it lies on the main commuting route from Louisville to the site, as well as sharing similar physical, economic and social characteristics. The counties included in this study are shown in Figure 1.

Neither the description of existing characteristics nor the range of issues discussed in this report are meant to be definitive and all inclusive. Both are intended to stimulate further study, discussion and planning at the state and local level. Kentucky is fortunate to have the lead time for assessing impacts in order to enhance the benefits and reduce the costs associated with large energy developments.

**The Synthetic Fuels Industry in Kentucky: An Assessment of Environmental Health Issues.*

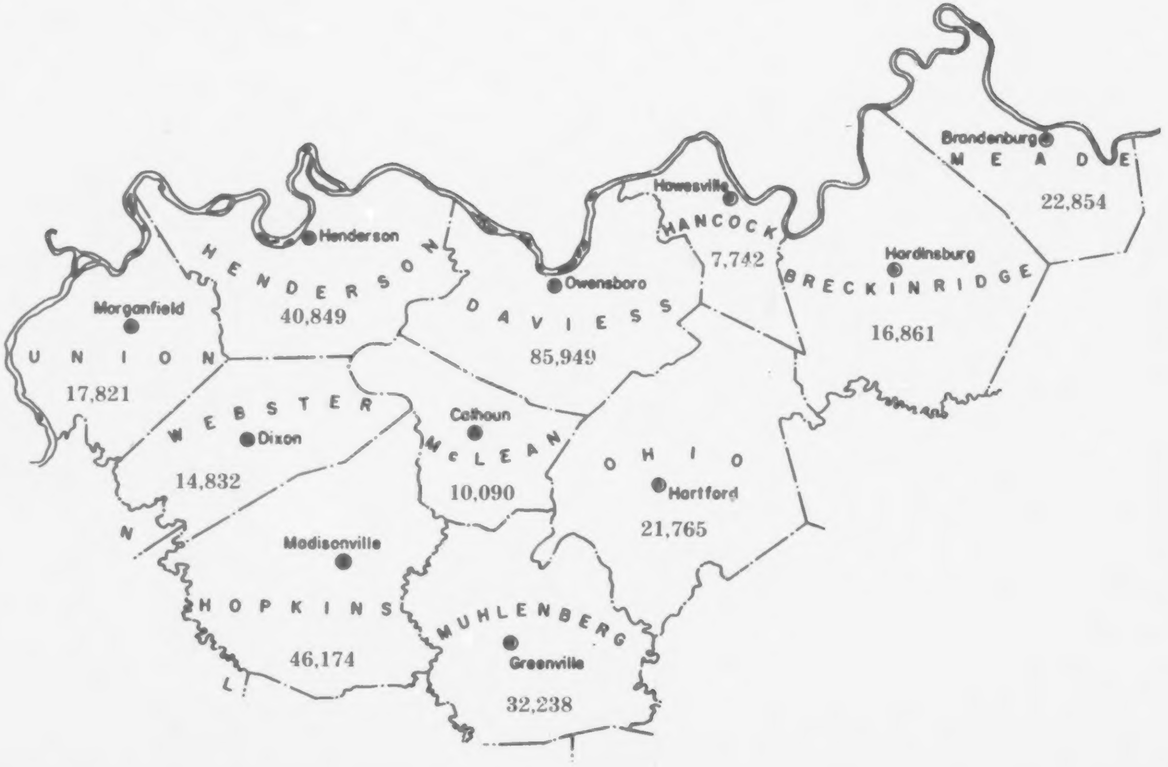
Brandenburg
MEADE
22,854
Hardinsburg
BRECKINRIDGE
16,861
Hawesville
HANCOCK
7,742
Owensboro
DAVIESS
85,949
Henderson
HENDERSON
40,849
Morganfield
UNION
17,821
WEBSTER
Dixon
14,832
Calhoun
McLEAN
10,090
OHIO
Hartford
21,765
Madisonville
HOPKINS
46,174
MUHLENBERG
Greenville
32,238
N
L

Figure 1
Population of Counties in Region
(1980)

COUNTY CHARACTERISTICS

Physical

The counties included here are primarily in the western Kentucky coal field, part of the larger Illinois or Eastern Interior Basin field. Breckinridge and Meade, in the tip of the eastern Pennyroyal, do not have a substantial coal resource but they do share in the other mineral resources of the area, mainly limestone, sand, gravel, natural gas and oil. Table 1* displays production data by county for the last six months of 1980. This was the first period for collecting the tax on all minerals under the new severance tax programs.

Under the other minerals (excluding coal) category, Breckinridge, Meade, Daviess, Union, Ohio and Muhlenberg produced 11.5% of the Kentucky total of 26.7 million tons; Daviess and Meade ranked fifth and sixth in production level in the state. Counties in the region also produced 61% of a state total of 3.6 million barrels of oil. Henderson, Union and Muhlenberg were the top three producers in the state. All of the counties except Meade and Breckinridge produced small amounts of natural gas.

The remaining coal resource in the western Kentucky coal field is estimated to be 38.6 billion tons distributed largely in Daviess, Henderson, Hopkins, McLean, Muhlenberg, Ohio, Union and Webster (greater than 1 billion tons of resource each).

In addition to minerals, the entire region has land suitable for general farming. A high percentage of the area is considered prime farmland particularly in Henderson, Daviess, McLean, Union and Webster Counties. The prime farmland generally lies in the major river basins; the Tradewater on the western border; the Ohio to the North and, bisecting the area, the Green River.

ECONOMIC CHARACTERISTICS

Manufacturing, mining and agriculture, the three major industry divisions in Kentucky, are also the major economic forces in the area. Agricultural production makes an important contribution to the income of each of these counties but mining contributes substantially more in Hopkins, Muhlenberg, Ohio and Union as does manufacturing in Daviess, Hancock and Henderson.

Agriculture

The preliminary report of the 1978 Census of Agriculture provides a major indication of the role of agriculture. In only two counties, Muhlenberg and Ohio, is there less than 50% of total county acreage in farmland. Even so, Ohio ranks with Daviess and Breckinridge as having the largest number of farms though Union's farms have the largest average size, 429 acres. There were 9,907 farms in the 11 counties in 1978.

The distribution of prime farmland is reflected in the agricultural output of each county as shown in Table 3. Union, Henderson, Daviess and Webster rank in the top five corn producers, together accounting for 19% of the state's production in 1979. Daviess and Henderson are the leading producers of soybeans, together accounting for 11% of the state's production in 1979. Tobacco, soybeans and corn are Kentucky's leading cash crops but only Daviess ranks in the 18 counties producing from 5 to 8 million pounds of tobacco a year.

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*See Appendix for all tables.

Daviess, Union, Henderson and Breckinridge led the area in farm cash receipts in 1979 as shown in Table 4. Total cash receipts were $287.9 million in 1979 at a farm employment level estimated to be 6,481 persons for the 11 counties. Farm cash receipts appear to be the leading source of income in Breckinridge, McLean, Webster and Meade Counties. Of these four, only McLean and Webster rank among the counties having over 150,000 acres of prime farmland.

Mining

The western Kentucky coal field includes 17 counties but the 9 coal producing counties selected here accounted for 41.7 million of the 43.1 million tons produced in 1979 (Table 5) in West Kentucky. This is thirteen million tons less than the peak production year in 1975. Production in these nine counties accounted for 28% of total state production in 1979.

At an average value per ton of West Kentucky steam coal in 1979 of $28.30, the 41.4 million tons was worth $1.17 billion in sales and $52.65 million in severance tax. In total wages for 1979, mining contributed $309.8 million to the economy of the 11 counties. Mining wages are the leading source of income in Hopkins, Muhlenberg, Union and Ohio Counties (Table 6).

Manufacturing

Manufacturing wages exceeded coal mining wages by $3 million, contributing $313.1 million to the area economy in 1979. Daviess and Henderson are the leading manufacturing counties in terms of employment and wages, followed by Hancock, Hopkins and Ohio (Tables 9 and 6). Shipments from manufacturing plants in all the counties were valued at $1.9 billion in 1977 (Census of Manufacturers).

According to the 1981 Kentucky Directory of Manufacturers the major manufacturing industries (in terms of employment of 100 or more persons at a single site) are apparel, food and food products, rubber and plastic products, electrical equipment, fabricated metals, lumber and wood products, and primary metals (aluminum). Hancock County is unique in having only a few plants which are large employers, mainly in the aluminum industry. Except for Meade and McLean, the other counties show numerous employers in the less than 100 employees range. This is particularly the case for lumber and wood products, stone, clay and glass based on the limestone, sand and gravel resource, and fabricated metals represented in numerous small machine shops. These shops plus small explosives manufacturers and wood pallet shops are support industries for mining as is particularly apparent in Muhlenberg County. Meade County, which has one large employer, the Olin Corporation, and McLean County, appear to have the least diversified manufacturing base.

EMPLOYMENT PATTERNS

Table 7 compares employment levels in 1976 and 1979 for both mining and manufacturing. While some counties experienced dramatic change in one or both areas, overall growth in employment was only 5% over the three-year period. For example, Union County expanded its employment, in both manufacturing (70% increase) and mining (41% increase). On the other hand, Muhlenberg had an 11% decrease in mining employment over the three-year period (no change in manufacturing) while Ohio had a 17% decrease in manufacturing employment (no change in mining).

In 1979, the unemployment rate in Union County of 3.4% was the lowest in the region (Table 8). The five counties exceeding the 1979 state average unemployment of 5.6% were Breckinridge, Hancock, Hopkins, McLean, and Meade. Breckinridge, Hopkins and McLean lost manufacturing jobs and, with Meade, have many workers commuting to manufacturing centers in counties also experiencing slow growth or higher than average unemployment including Hardin (6.5%), Hancock and Daviess. Unemployment rates in 1980 and 1981 indicate that this trend has continued.

Table 9 shows that manufacturing employment in the region is almost double that of mining; offers some 4000 more jobs than wholesale and retail trade but is exceeded slightly by the services industry. Daviess and Henderson are the retail trade centers within Kentucky for most of the area as shown in Table 10. These two counties capture more retail sales than the surrounding counties of Union, McLean, Webster and Hancock, whose residents probably shop for many items in Owensboro, Henderson and Evansville, Indiana. Breckinridge, Muhlenberg and Hopkins Counties capture about 50% of resident buying income perhaps because of distance from major centers.

Mining employment is concentrated in four counties, Hopkins, Muhlenberg, Ohio and Union; manufacturing employment is concentrated in Daviess, Hancock, Henderson and Hopkins; trade and services employment exceeds both mining and manufacturing in Daviess, Henderson, Hopkins and slightly in Webster. Agriculture accounts for 7% of the direct employment in the region.

LABOR FORCE CHARACTERISTICS

Labor force participation among the 11 counties has increased 14% since 1976, most marked in Daviess, Henderson, Hancock, Meade, Union and Webster. (See Table 11.) Movement of the labor force among the 11 counties also indicates the economic relationships in the region. From projections produced by the Statewide Traffic Model, an estimate of work related travel patterns from each of these eleven counties to another county in 1980 has been made. The county clusters presented in Figure 2 show those counties to which 100 or more work trips per day are estimated to occur.

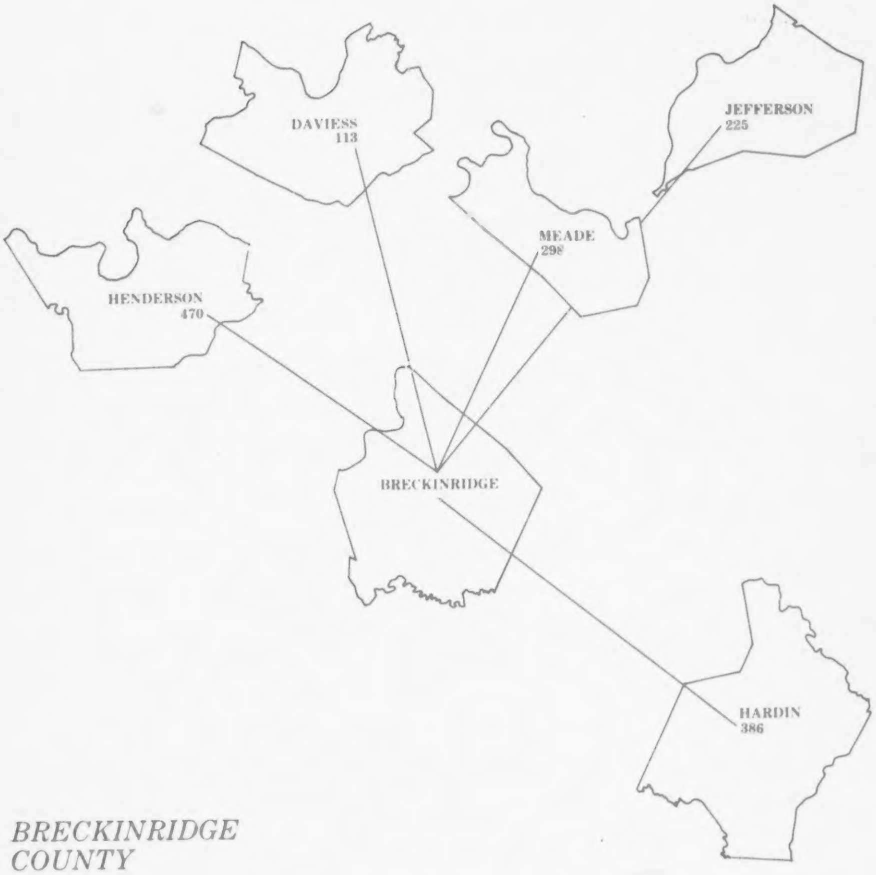
These patterns demonstrate again the role of mining and manufacturing in providing the basic employment from which secondary and support industries develop. Daviess County attracts 3911 of the trips; Hancock, 1927; Henderson 1758; Hopkins, 1536; Muhlenberg, 1547; and Webster, 1026 trips. Hopkins, Muhlenberg, Webster and, to a lesser extent, McLean and Ohio have significant levels of intercounty commuting. Breckinridge has the highest number of trips to Henderson County; Union and Webster are also oriented to Henderson. Henderson, Daviess and Hancock share a large commuting pool. All of the counties are understated because of Hoosiers commuting into Kentucky and of other border county commuting into counties such as Breckinridge, Meade, Ohio, and Union which were not analyzed. Nevertheless, the movement of the labor force from each of the 11 counties to other counties is indicative of the economic links between the counties and the relative economic strength of each.

Farm labor cash wages were reported to have been $3.09 an hour in 1979, 19 cents above the Federal minimum. In other categories, average weekly wages in 1979 indicate the relatively high wage rates of coal mining in Hopkins, Muhlenberg, Union and Webster in contrast to manufacturing. It explains why mining with half the work force of manufacturing contributes almost as much in wages as manufacturing in the region (Table 12). Only Hancock and Daviess exceed the state average for manufacturing probably a reflection of the size and nature of the employers particularly in Hancock. Of the counties with larger urban centers, only Hopkins exceeds the state average wage in trade and only Henderson in service wages, where Hopkins had the lowest wages.

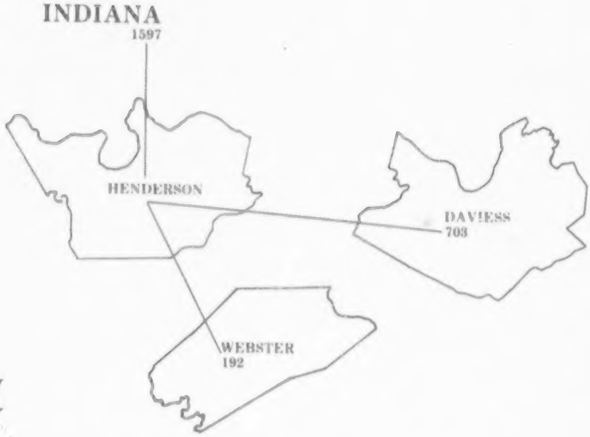
An estimated 41% of the labor force is female in the eleven counties. This is somewhat below the rate for the U.S. which was estimated to be 57% in 1979. However, in every county, female unemployment exceeded male. Women slightly exceeded men in educational level in all except two counties, Ohio and Meade in 1970 (Table 14). For the region as a whole, both men and women slightly exceeded the state education average.

Three vocational education regions serve the 11 counties with two types of state operated facilities. These are area vocational schools run in conjunction with high schools and vocational technical schools providing post-secondary training. Figure 3 shows the locations of each institution. The regions are alloted funds each year to use in response to industry requests for special training programs. The regions also work with local manpower service offices and federal training funds to provide adult upgrade programs.

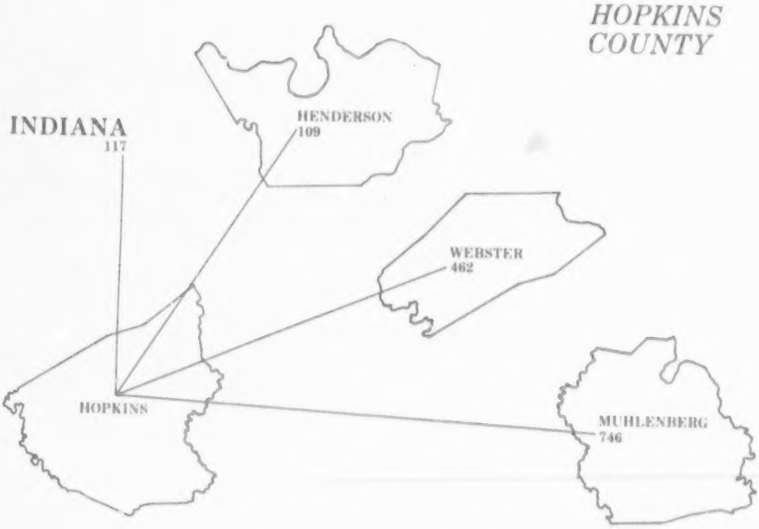
Figure 2
Labor Force Commuting Patterns


DAVIESS
113
JEFFERSON
225
MEADE
298
HENDERSON
470
BRECKINRIDGE
HARDIN
386

*BRECKINRIDGE
COUNTY*

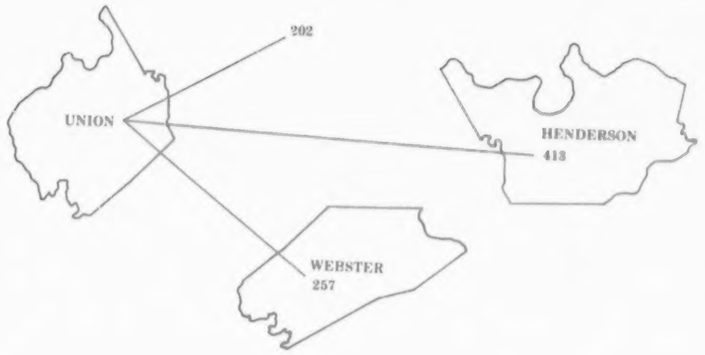

INDIANA
1597
HENDERSON
DAVIESS
703
WEBSTER
192

HENDERSON COUNTY

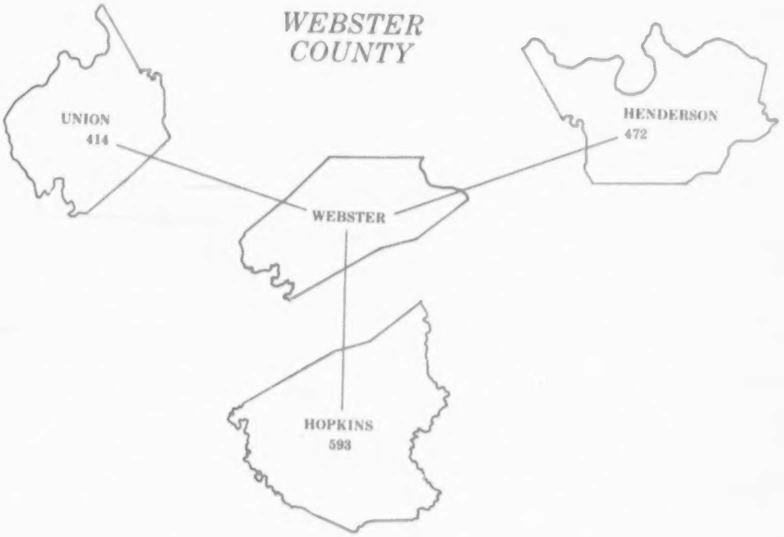

INDIANA
117
HENDERSON
109
WEBSTER
462
HOPKINS
MUHLENBERG
746

HOPKINS COUNTY

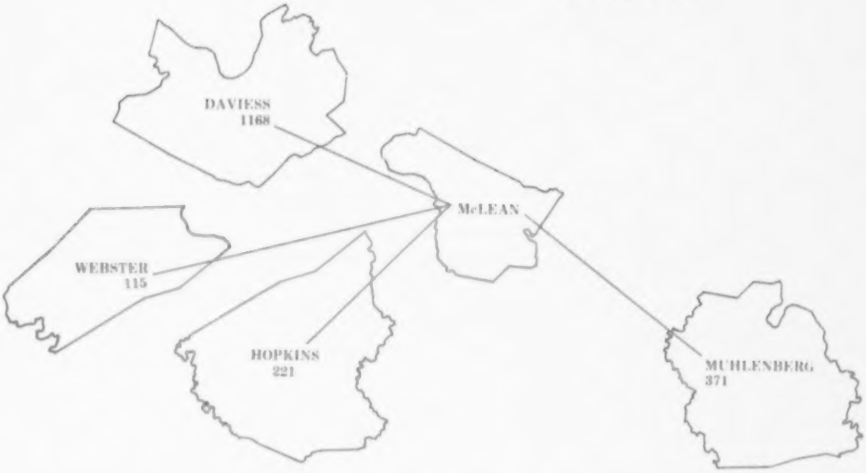
UNION COUNTY


202
UNION
HENDERSON
418
WEBSTER
257

WEBSTER COUNTY


UNION
414
HENDERSON
472
WEBSTER
HOPKINS
593

McLEAN COUNTY


DAVIESS
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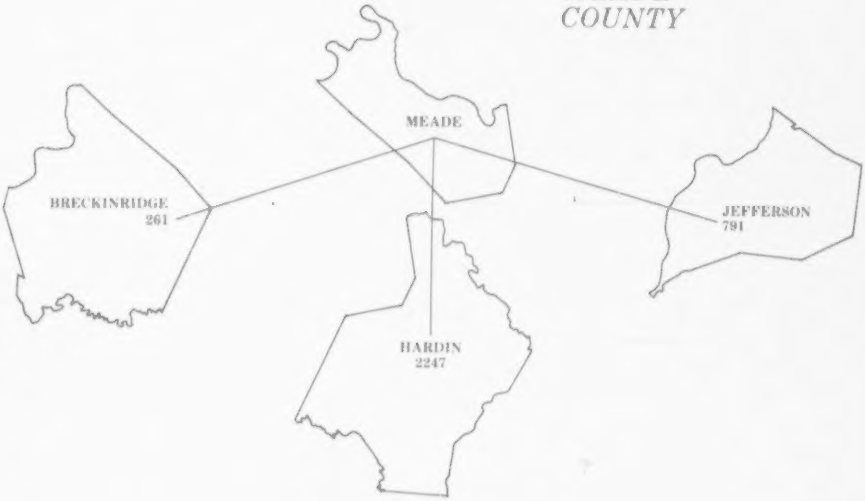
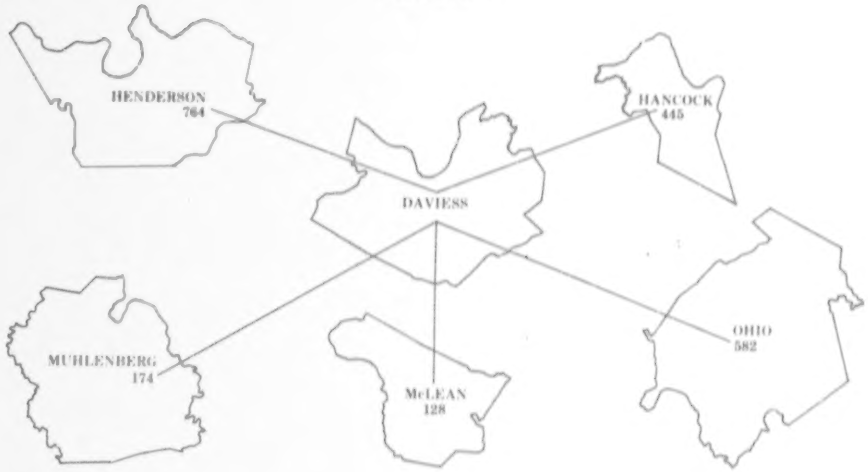
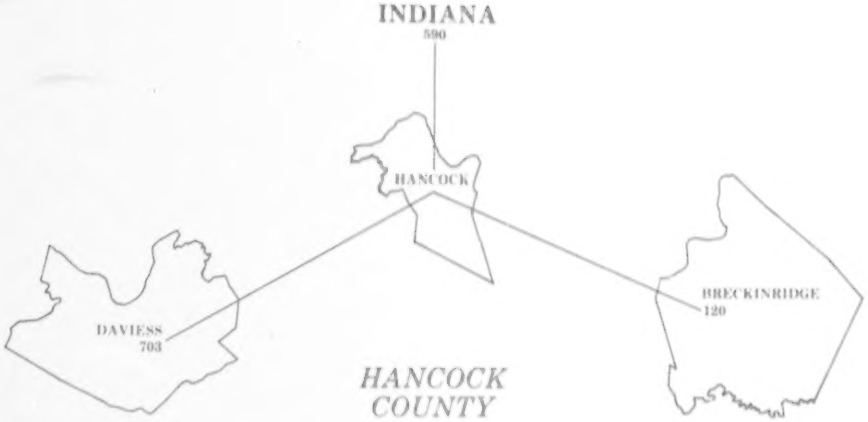
McLEAN
WEBSTER
115
HOPKINS
221
MUHLENBERG
371

MEADE COUNTY

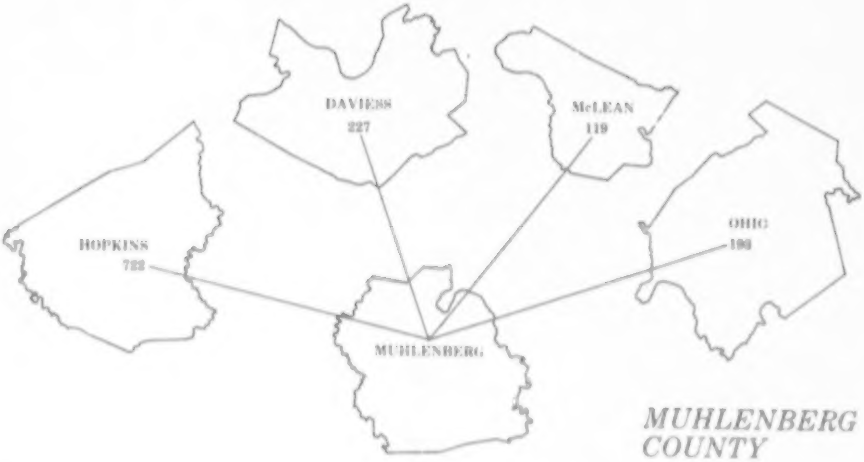

MEADE
BRECKINRIDGE
261
JEFFERSON
791
HARDIN
2247

DAVIESS COUNTY

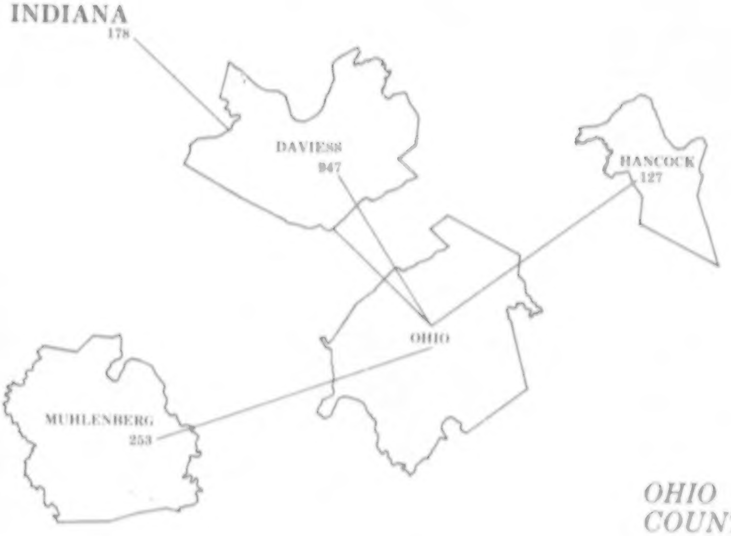

HENDERSON
764
HANCOCK
445
DAVIESS
MUHLENBERG
174
McLEAN
128
OHIO
582


INDIANA
590
HANCOCK
DAVIESS
703
BRECKINRIDGE
120

HANCOCK COUNTY


DAVIESS
227
McLEAN
119
HOPKINS
722
OHIO
196
MUHLENBERG

MUHLENBERG COUNTY


INDIANA
178
DAVIESS
947
HANCOCK
127
OHIO
MUHLENBERG
253

OHIO COUNTY

DEMOGRAPHIC AND SOCIAL CHARACTERISTICS

Population Trends

Several counties, as shown in Table 15, exceeded the state average of 13.7% population growth from 1970 - 80. These include Meade County which is affected by the Fort Knox military base and in-migration from the Louisville metropolitan area and Hopkins, Ohio and Muhlenberg, the leading coal producers. Only Daviess and Hancock fell significantly below the state average, perhaps reflecting the results of the 1974 - 75 recession and subsequent slower growth of manufacturing employment in the state generally. As shown in Table 16, six of the eleven counties exceed the state average for persons 65 and older. These same six counties, Breckinridge, Hopkins, McLean, Muhlenberg, Ohio, and Webster, have less diversity in the economic base and thus may be reflecting the aging trend in the farm population nationally and in Kentucky. On the other hand, Meade and Union have higher percentages in the 0 - 19 age group, probably a result of Fort Knox in Meade and the Job Corps Center in Union.

School population in kindergarten through grade 12 is projected to drop in all of the counties between the 1980 - 81 school year and 1985 - 86 (Table 17). McLean, Daviess, and Breckinridge show the sharpest declines while Muhlenberg, Ohio and Webster show very small declines.

Household Characteristics

Table 18 shows the distribution of household characteristics which are also indicators of the age distribution, family structure and relative wealth of the counties. In each county but Meade the greatest number of households is headed by persons forty-five or older. Hancock, Union and McLean show less than 1,000 units difference between household heads over and under 45. Meade also has the smallest percent of non-family households, that is a household of 1 person or unrelated individuals. Most of the counties had 20 - 23% in this category. In Breckinridge, Webster, Muhlenberg and Hopkins Counties this feature may be related to the higher than average age group over 65, in the 13 to 14% range in contrast to Meade's 6%. Henderson and Daviess metropolitan areas would be attracting single or unrelated individuals into the labor force. They also have the highest percentage of families headed by females, about 11% each, whereas Breckinridge and Meade are at the low end of this indicator at about 7%. Female-headed families are generally at the lower end of the income scale and the elderly often have income problems also. The highest percentage of low income families is in Henderson County (Table 21). Its 48% level is probably overstated because the median family income is derived from the Evansville metropolitan area. Daviess County is 10% lower. However, other counties in which 14 to 16% of the population is over 65 and having 40% or more low income families are McLean, Ohio and Webster.

Income Levels

Per capita personal income growth has exceeded the state average of 63% from 1974 to 1979 in eight of the eleven counties (Table 19). The leaders, Muhlenberg and Webster, showed 78% growth and Henderson, 74%, while Meade and Breckinridge showed only 52% and 55% growth respectively. The components of personal income used by the Bureau of Economic Analysis in its estimated county disaggregations suggest that mining and federal employment were the chief sources of change in Muhlenberg County; construction and manufacturing led Webster County; and transportation, communication, public utilities and manufacturing were the major sources of growth in Henderson. In Breckinridge and Meade, gains in wholesale trade, manufacturing and services did not offset the smaller growth in farm income.

Per capita income growth over a period of time is a measure of change which can indicate success in developing new sources of income, growth in the wage base and in use of existing resources and shifts in the economy of an area. Slower growth usually means that individuals at or below the poverty level have more difficulty finding jobs and increasing income.

The most recent estimates also show Breckinridge and Meade Counties as having the highest percentage of individuals below poverty level in the 11 counties and exceeding the state level. Daviess, Henderson and Hancock had the lowest ranking of the group (Table 20). The federal guidelines establishing the poverty level for 1978 placed a non-farm, single person in poverty if he made less than $3,140 a year; on a farm, less than $2,960. A farm family of four was below poverty level at $5,270 and a non-farm family of four at $6,200.

Another measure of relative wealth, median family income, is shown in Table 21. Again, Daviess, Henderson and Hancock led the eleven counties and exceeded the state while Breckinridge, Webster, McLean and Ohio ranged from $2,200 to $2,600 less than the state estimate of $13,700 in 1979. Forty percent of families in the state fell below 80% of the median income in 1979. In each county, median family income is well above the poverty level, and reflects the weekly wage rates shown in Table 12. Henderson County shows an unusually high percent of low income families (48.5%) perhaps because its median income level is derived from data for the Evansville metropolitan area. Otherwise, only Ohio, McLean and Webster are above the state percentage for low income families while Hancock, Meade and Union are 10 to 13% lower than the state non-metropolitan percentage. In the first three counties, this may be a reflection of reliance on farm income in contrast to the effect of manufacturing in Hancock and Union and Ft. Knox in Meade County. The individual military wage scales affected Meade County adversely for individuals below the poverty level as well as the lack of economic diversification.

GOVERNMENTAL UNITS

Counties, cities and school districts are the major local units of government in Kentucky though numerous special purpose districts also exist. Of major interest here are those for water, library, health, and volunteer fire protection purposes. As is true throughout Kentucky, the cities in the 11 counties are predominantly smaller than 5,000 in population. Figure 4 shows the major centers in each county.

There are 46 cities in the eleven counties, 33 having less than 2,000 population; nine having from 2,000 to 6,000 population; one at 17,000 (Madisonville, Hopkins County); then jumping to 24,000 in Henderson (Henderson County); and 54,000 in Owensboro (Daviess County). Total city population is 157,368 or 47% of the population of the eleven counties. In addition, there are many unincorporated small communities. The scattered nature of these communities and their size is indicative of the rural orientation and cultural patterns of the area.

Services

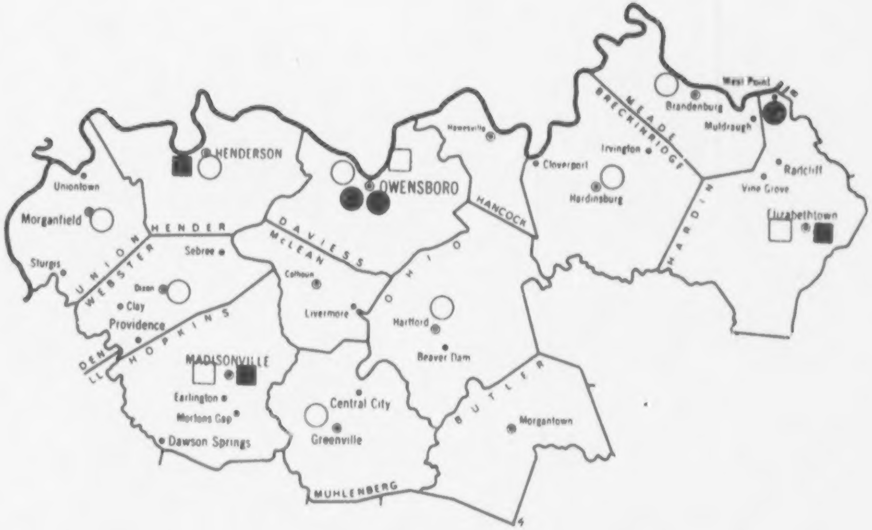
The major centers shown in Figure 4 typically provide the basic municipal services of water, sewer, sanitation, fire, police and streets and roads. The level of service cannot be assessed fully in a report of this nature. But, according to Industrial Resource brochures and other studies, most of them have secondary sewage treatment, water distribution systems and private or municipal garbage collection. County water districts are common as is City/County use of landfills. A number of engineering and planning studies were reported underway or needing funding to expand or upgrade systems. The most pressing need for new or expanded services appears to exist in Breckinridge and Meade Counties for water, sewer and sanitary landfills. Table 24, prepared by Watkins and Associates in a report for Ashland Synthetic Fuels, Inc., assesses these facilities for both incorporated and unincorporated areas.

Daviess and Henderson, the metropolitan areas, have the most developed level of services. The City of Henderson and the City of Owensboro water utilities provide water supply for the several water districts in the two counties. Sophisticated levels of secondary sewage treatment and collection have been developed. Both have professionally staffed fire departments. Daviess County has 12 county fire stations and twenty professional firemen as well as volunteers. Henderson County has 9 volunteer fire units. Both have larger county police forces as well. In the other counties, fire services appear to be provided largely by volunteer fire districts. Police protection is provided in small county and city departments. Municipal parks, golf courses, ball parks and tennis and swimming areas are common.

Henderson County has a modern jail facility which is usually filled to capacity. Daviess County is currently renovating its jail and will increase capacity by adding a juvenile area. Its 66 beds are usually full. Most of the other county jails do not regularly operate at capacity except for Webster. Some need extensive renovation and repair.

Figure 3
Post-secondary Education in Region

○ Area Vocational Education Centers
□ State Vocational Technical Schools
● Senior Colleges
■ Community Colleges


Uniontown
Morganfield
Sturgis
UNION
WEBSTER
Dixon
Clay
Providence
HENDERSON
HENDER
Sebree
DEN
LL
HOPKINS
MADISONVILLE
Earlington
Mortons Gap
Dawson Springs
OWENSBORO
DAVIESS
McLEAN
Calhoun
Livermore
OHIO
Hartford
Beaver Dam
Central City
Greenville
MUHLENBERG
BUTLER
Morgantown
HANCOCK
Hawesville
Cloverport
Irvington
Hardinsburg
BRECKINRIDGE
MEADE
Brandenburg
West Point
Muldraugh
HARDIN
Radcliff
Vine Grove
Elizabethtown

Urban Land Use

Urban and built up land is reported by the U.S. Soil Conservation Service in contiguous units of 40 acres or larger with a density of one or more residences or other structures per 1.5 acres. In strip developments the density is 20 or more residences or other structures per mile. Land use for residential, commercial and industrial sites and public facilities is called urban land. As Table 22 shows there was little change in the amount of urban land in the 60s but it expanded rapidly in the 70s particularly in Hopkins, Meade, Henderson and Ohio Counties. Meade County's inmigration from the Louisville area, the effect of manufacturing growth and the coal boom in the early and mid 70s on Hopkins, Ohio, and Henderson are the sources of these shifts.

Cities and counties control development patterns locally through planning and zoning. Land use controls now in existence are shown in Table 23. Planning and zoning has been in effect to some degree since the early 70s in all these counties except for Meade. Though zoning and subdivision regulation is mainly practiced by the major urban centers, Henderson County recently had a court ruling overturning existing zoning.

School Districts

School districts are largely county-wide, though six of the cities have retained independent districts as shown in Table 25. Most of the systems have attained standard or comprehensive accreditation in the elementary and secondary schools except for Breckinridge and Ohio Counties where the elementary schools include several with basic or provisional accreditation. Owensboro has an independent school district and a large parochial system.

Local Revenue Structure: Schools, Counties, Cities

The tax base supporting schools ranges from a high of $950 million in assessed value in Daviess County (highest population) to a low of $147 million in Hancock County (smallest population). City districts except for Owensboro have a much smaller base (Table 25). Remaining bonding capacity, also shown in Table 25, is rather small in most of the districts and seven of the districts have none including Owensboro Independent and Breckinridge County. Henderson County has the highest bonding capacity at $4.4 million. The local financial index and percent deviation from the state average is a measure of local willingness to support the schools relative to assessment levels.

School districts receive substantial state funding primarily through the Minimum Foundation and Power Equalization program and for student fees and textbooks. Minimum foundation funds are allocated in a series of increments which begin with the classroom unit of 27 children in average daily attendance and, for each increment of 8 classrooms, provides additional funds for principals, physical education, art and music so that districts have funds for special and general teaching staff and supervisors. It also includes allocations for operating and overhead costs, capital outlays and transportation. Power Equalization Funding is based on the number of children in average daily attendance in relation to the district assessment and that ratio's relationship to the wealthiest county district in the state. Table 25 shows amounts allocated to each of the districts.

Tax rates for schools, cities and counties shown in Tables 24 and 26 are the result of two state laws which attempt to control the growth of property taxes through rates rather than assessment levels.

Kentucky's constitution requires assessment at 100% of fair market value and in 1965, the Court of Appeals required counties to do so. The real estate assessment-to-sales ratio for counties most recently reported by the Kentucky Department of Revenue shows a range for the 11 counties from 78.5 in Union County to 99.9 in Webster County; five counties cluster in the 88.5 to the 9.1.0 range; four in the 78.5 to 82.8 range.

Control over tax rates began with the 1965 "rollback" law following the court requirement. That law required the application of the previous year's rate plus up to 10% growth in revenue for each of the 3 succeeding years after which the rate being levied became the basis for the maximum tax rate which was adjusted annually to allow for net assessment growth.

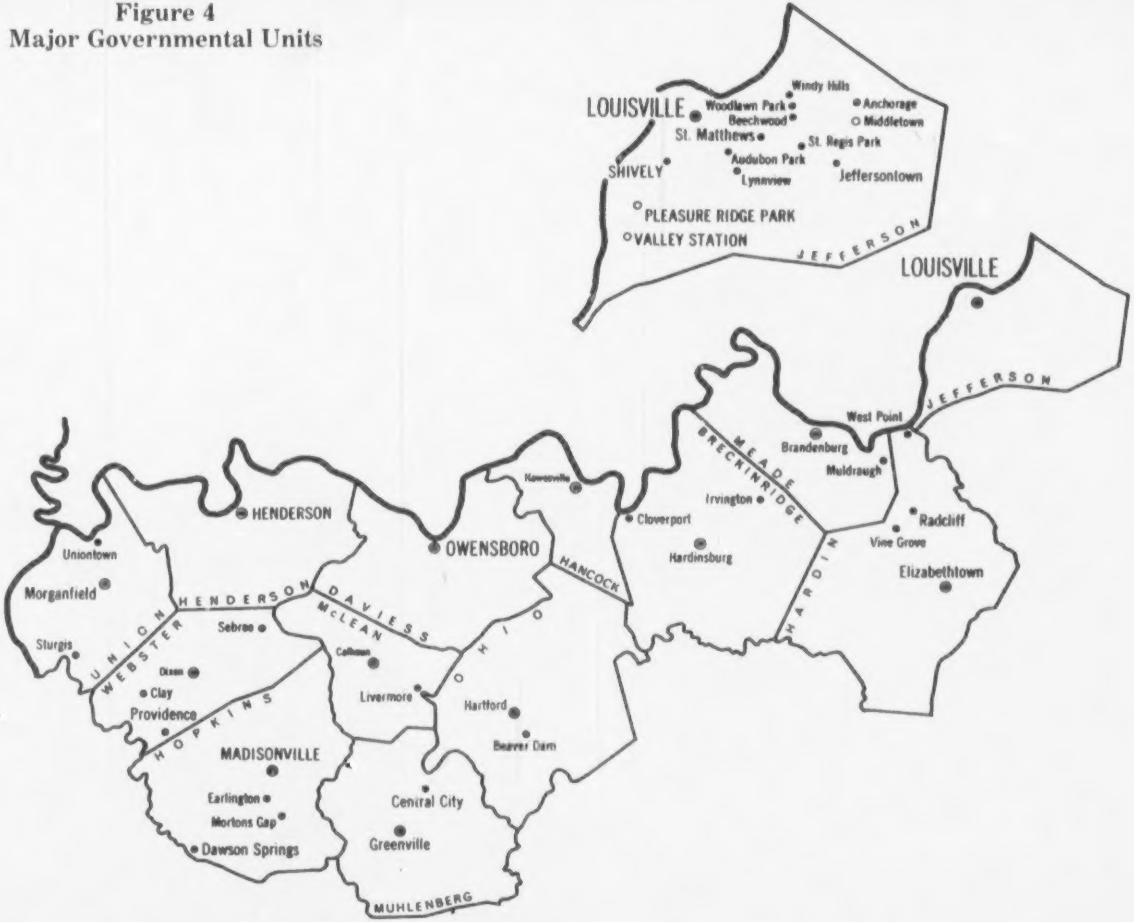
A special session of the 1979 General Assembly then passed House Bill 44. Local units of government now calculate the maximum tax rate so that, applied to the current year's assessment, excluding new property and personal property, it produces an amount of revenue equal to that produced from real property in the preceding year. The rate must not be less than one which would produce the same amount of revenue from all classes of property as was produced from all classes the preceding year. If a local government wishes to increase its revenue from existing real property up to or over the 4% limit it can do so if it gives public notice and holds a hearing. Rates bringing in excess of the 4% limit are then subject to petition and referendum.

City assessed valuation is not given here as there is no central reporting requirement for them. Cities may, and many do, use the county assessment. Cities can also establish their own assessments and appeals procedures.

Local units of government are also restricted by the state constitution in borrowing. Loans of less than a year's maturity must be repaid out of current year revenues. No indebtedness beyond the current year's revenue can be incurred without a two-thirds majority of residents voting approval. Thus the general obligation (G.O.) bond (limited to 2% of assessed values 2 years prior to date of issue) is seldom used in Kentucky. Table 27 shows the current bonding capacity of the counties and the small amount of debt. Two cities, Irvington (Breckinridge) and Madisonville (Hopkins) have issued G.O. bonds.

These limits on indebtedness have caused revenue bonds to be a principal means of financing local capital construction for many municipal functions. Special districts, boards and authorities are created which can issue bonds supported by fees or taxing authority.

Figure 4
Major Governmental Units


LOUISVILLE
Windy Hills
Woodlawn Park
Beechwood
Anchorage
Middletown
St. Matthews
St. Regis Park
Audubon Park
Lynnview
Jeffersontown
SHIVELY
PLEASURE RIDGE PARK
VALLEY STATION
JEFFERSON
LOUISVILLE
JEFFERSON
West Point
Brandenburg
Muldraugh
MEADE
BRECKINRIDGE
Irvington
Cloverport
Hardinsburg
Radcliff
Vine Grove
Elizabethtown
HARDIN
Hawesville
HANCOCK
OWENSBORO
DAVIESS
HENDERSON
HENDERSON
Uniontown
Morganfield
Sturgis
UNION
WEBSTER
Sebree
Dixon
Clay
Providence
McLEAN
Calhoun
Livermore
OHIO
Hartford
Beaver Dam
HOPKINS
MADISONVILLE
Earlington
Mortons Gap
Dawson Springs
Central City
Greenville
MUHLENBERG

County and city revenue sources other than the property tax and bonding are limited mainly to occupational license (payroll), taxes and business license taxes by the constitution. Hancock County is one of 7 in the state levying an occupational tax. Only 3 cities in the area, Owensboro, Madisonville and Dawson Springs, levy from 1 to 1 1/2% occupational tax though many charge annual occupational and business license fees and municipal service fees.

Severance Taxes

A change in the coal severance tax distribution formula, enactment of a tax on other minerals, such as limestone, sand and gravel, the addition of counties with coal haul roads as recipients of a portion of the tax and a requirement that cities be allocated 10% of a county amount of the severance and minerals tax were accomplished in House Bill 970 by the 1980 General Assembly. The bill established the local Economic Assistance Fund from which eligible local governments in the coal and other mineral producing counties or coal haul road counties receive quarterly allocations based on a formula beginning in July, 1981.

The purpose of the fund, as broadly stated in House Bill 970, is to provide for the improvement of environment for new industry and the quality of life for residents. Table 28 shows the estimated allocations for the fiscal year beginning July 1. These may change depending on actual severance tax income.

Recreation and Cultural Opportunities

Citizens in the eleven counties have access to state and locally developed park and recreation programs oriented largely to outdoor sports and games. State parks are a major resource ranging from Rough River in Breckinridge County, the Land Between the Lakes, Lake Barkley and Kentucky Lake on the western edge of the area and Pennyrile Forest to the south, to John James Audubon in Henderson and Ben Hawes in Daviess. Swimming, boating, fishing, golf, tennis, camping, organized activities, nature and wildlife study areas are typically available at the parks.

Many of the cities shown in Figure 4 provide municipal parks with ball fields, tennis courts, golf courses and swimming pools. Owensboro offers a Symphony and Youth Orchestra, Fine Arts and Natural History Museums, an annual Festival of the Arts and theater. Two private liberal arts colleges, Brescia and Kentucky Wesleyan, are located there.

All of the counties offer library services except McLean. Hopkins and Daviess have joint city-county service funded by appropriation while the remaining eight levy a library district tax.

ENERGY DEVELOPMENT ISSUES

As the preceding discussion illustrates the three counties chosen as project sites divide into two substantially different areas.

Breckinridge County is dominantly agricultural in employment and production; has 3 small incorporated areas which appear to be active, small retail centers; sends most of its labor force outside the county to work; has followed statewide trends in population growth and unemployment but has experienced little recent change in the size of the labor force, perhaps a reflection of an older population.

Daviess and Henderson Counties, in contrast, are metropolitan areas in which Owensboro, in particular, is a trade and service center for surrounding counties. Both are manufacturing employment centers and agricultural leaders as well. They participated in the manufacturing growth in Kentucky during the 1960s and early 70s; have a younger population and a growing labor force. Henderson has recently experienced a more expansive period than Daviess in population growth, increases in the labor force and in manufacturing jobs. Urban services and housing appear to have kept up with the demand evidenced by these changes, particularly in Henderson through 1979.

These three counties and their cities will experience the primary impact of synfuel plant construction in Kentucky. It will stem from the size of the construction work force and the rapidity with which it grows and declines. Surrounding counties will receive some portion of impact through job opportunities, commuting traffic patterns, housing and associated services demand. The direction of the impact can be partially estimated from similar indicators. Webster, for example, shows a 27% growth in the labor force since 1976 and a surge of unemployment in 1980 while McLean's labor force dropped 12% but maintained a high unemployment rate. Meade and Union Counties showed marked labor force growth but only Union brought in enough new jobs to keep unemployment down.

These socio-economic factors which condition the capacity of an area to absorb and manage rapid population growth, indicate that the visible impacts may be very different in the two areas particularly during the construction peak period. Construction schedules and craft labor demands are and will remain highly uncertain for some time. The current project schedules showing a rapid buildup in 1985 to a peak of 27,000 workers in early 1986 will be used for this discussion.

The degree of uncertainty not only about schedules but also about the size of the work force is illustrated by Denver Research Institute case studies of ten power plants. One conclusion was that none of the work force estimates came within plus or minus 30% of what actually occurred.

Despite these uncertainties the stages of impact can be defined and major issues identified. That is the purpose of the discussion in this portion of the report. The issues derive from the two main phases of impact - first, construction and second, operations and coal production.

CONSTRUCTION IMPACT

The construction work force would build up in three stages. In the first stage, it would consist of local and daily commuters. As craft demand increases, there would be an influx of weekly commuters (workers living near the site during the week and returning home on weekends). As the construction peak is approached in 1986, demand would make it feasible for workers to relocate and seek housing for families for a year or more residence in the area. Any changes in the construction schedules of the four plants will affect relocation decisions as these will indicate the length of time jobs would be available and the worker's ability to move from site to site as craft requirements change at each site.

Population projections driven by construction labor demand are prepared and kept up to date by the University of Louisville's Urban Studies Center by quarter of the construction schedule for both synfuel and power plants. Current estimates of relocating workers show that 9,261 workers (an average of 4 quarters) would relocate in Kentucky in 1986, most of them bringing families. The total influx for the region would be an estimated 34,000 persons. Population changes currently estimated are presented in Table 29.

The specific impact issues each community or citizens within the area will find important may vary considerably over time and in degree but the effects of construction population growth will be felt in the following broad categories.

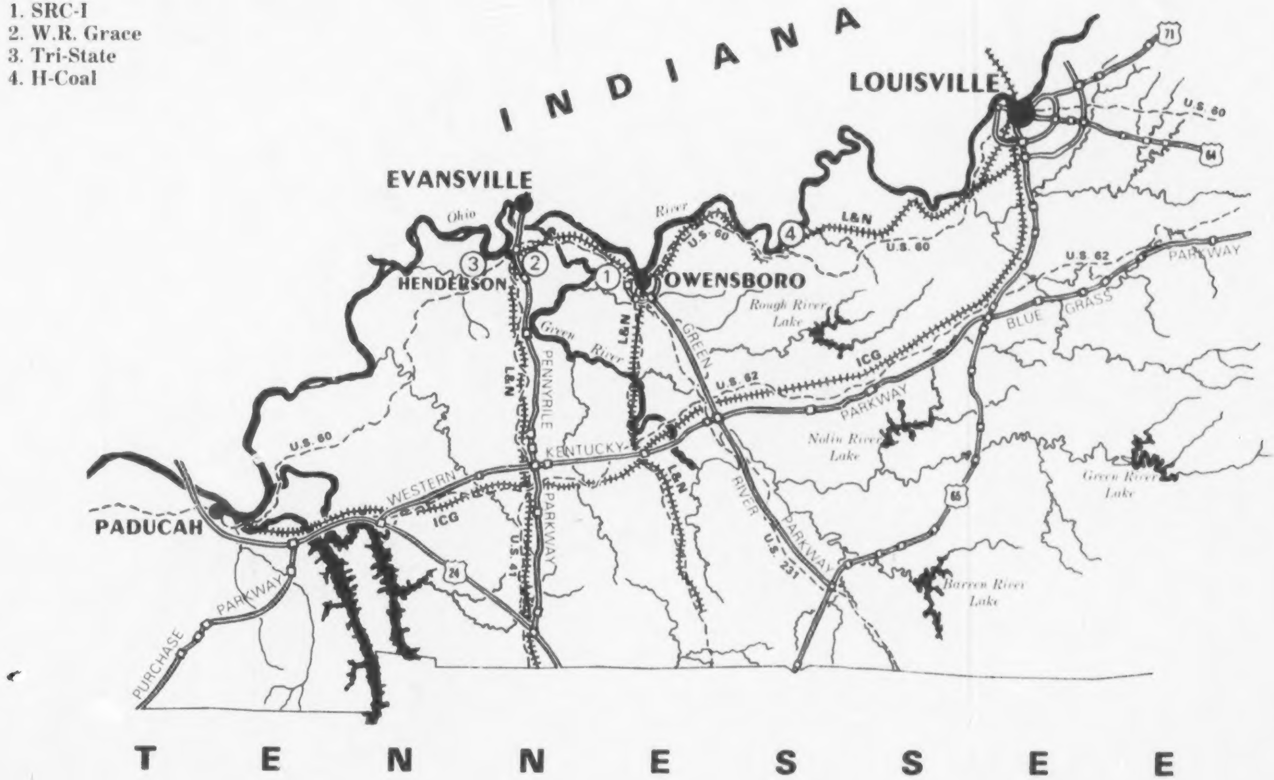
Transportation

A 75-mile radius has been accepted as the likely daily commuting range around each site. Major long distance commuting routes are readily identifiable and usually feed into U.S. 60 whether in Breckinridge, Daviess or Henderson County. In addition, the residential choices of weekly commuters and of in-migrants will not only change that area's traffic patterns but also affect local routes leading into U.S. 60.

U.S. 60 is already a heavily used road with a number of existing or potential spots where volume increases will lower the level of service - the speed and safety of travel. Improvements to U.S. 60 and to immediate site access roads can include traffic management techniques as well as construction.

In this category and many others, capital improvements would require lead time for planning and expenditures in the millions of dollars by the state. Projects announced recently by the Kentucky Department of Transportation that would ease traffic problems include acquisition of right-of-way for the Henderson Bypass and interchanges with Audubon Parkway at Ky 1554 and 1078.

Figure 5
Major Transportation Arteries: Highways, Rivers, and Railroads



1. SRC-I
2. W.R. Grace
3. Tri-State
4. H-Coal

INDIANA
LOUISVILLE
EVANSVILLE
HENDERSON
OWENSBORO
PADUCAH
TENNESSEE
Ohio
River
Green
River
Rough River Lake
Nolin River Lake
Green River Lake
Barren River Lake
L&N
ICG
U.S. 60
U.S. 62
U.S. 41
U.S. 231
71
64
65
24
BLUE GRASS PARKWAY
PARKWAY
GREEN RIVER PARKWAY
PENNYRILE PARKWAY
WESTERN KENTUCKY PARKWAY
PURCHASE PARKWAY
1
2
3
4

The traffic impacts would also be short term while highway improvements must be justified by long-term benefits after project construction. Construction may also overlap in time with project construction producing more congestion.

Whether or not further highway construction is undertaken, the major traffic management techniques able to control volume and maintain adequate service would be carpooling, vanpooling or busing for workers.

Traffic will be among the most obvious impacts to the residents living or working along U.S. 60. Assuming the projects use shifts and schedule them on off-peak traffic hours, the normal flow will be higher affecting routing highway access and travel time. Similar effects may occur in areas where significant numbers of workers live temporarily. The extent to which commuters will use back roads as alternate routes to the parkways is unpredictable and could visibly increase the traffic volume on lightly traveled county roads in all of the adjoining counties.

Thus a wide range of people whether engaged in commercial, manufacturing, farming, schools or any number of activities may feel the traffic impact over the short term.

Housing

The residential choices of construction workers who are commuting weekly or relocate can be generally assumed to go first where the housing vacancies exist in all types of rental or single family units. This assumption will be modified by the housing preferences of the work force. Construction craft workers regularly involved in large projects often bring in mobile homes or recreational vehicles rather than using existing housing. Travel distance from work and any special incentives for car and vanpooling could affect weekly commuter choices. Location of regional trade areas and other municipal and school services would be an additional concern of relocating workers and their families. These factors explain the estimated distribution of relocation. A high demand for temporary housing and rental units can be expected from the work force and lesser demand to purchase single family units. Factors controlling the local housing market at the time will be very influential in housing availability because of their effect on risk taking by developers. Building to meet short term demand requires an estimation of re-sale or rental demand after the temporary increase or some guarantee that the investment by builder or buyer will not be lost.

Kentucky has developed a severe housing shortage in the last six years. But, the counties which are expected to receive most of the impact of weekly commuters and relocating workers and families are in a portion of the state which came within 15% or better of meeting need. According to the 1980 Annual Housing Report of the Urban Studies Center, University of Louisville, Henderson County is estimated to have met need while Daviess County came within 8%. This data does not account for mobile homes. These two counties and Vanderburgh County, Indiana, will receive the majority of relocating workers and their families. According to the 1980 Housing Report, the average rate of growth in housing demand in Kentucky counties has been between 2% and 3% a year.

Counties estimated to exceed this level of demand include Daviess, Hancock, Union, and Meade; lagging counties include Breckinridge, Hopkins and Muhlenberg. The Report further states that "it is very probable that the relatively large numbers of mobile homes shipped to buyers in Kentucky has gone to meet substantial portions of the estimated housing need in rural Kentucky." Green River Area Development District indicates that 50% of McLean County's recent housing is mobile homes. A report prepared for Ashland Synthetic Fuels, Inc. by Watkins and Associates indicates that, from 1970-78, 28% of the additions to the housing stock in Breckinridge and 33% in Meade were mobile homes.

Should the housing market continue to operate as it has in recent years, mobile homes may well be a major response to construction worker demand. The potential impact of this on the affected counties will be determined by local planning and zoning regulations. Green River Area Development District's Energy Impact Mitigation Plan for housing related to construction of SRC-I at Newman in Daviess County and the Big Rivers Electric Corporation's D.B. Wilson unit states that: "Many of the GRADD cities and counties have existing zoning ordinances and subdivision regulations which cover the placement of mobile homes and the development of mobile home parks. Due to individual city and county preferences, mobile home requirements and restrictions vary from county to county. Not only can the zoning districts for locating mobile homes differ, but the definition of what constitutes a mobile home is not standard. While each city's and county's ordinance is different, mobile homes and mobile home park development is generally restricted to medium and high density Residential (R-2, R-3, R-4) or Agriculture (AG, A-V, A-R) zoned land." Only 117 lots for mobile homes were found to be available in mobile home parks in the GRADD and 78 lots appeared available in Breckinridge and Meade Counties where location is less restricted. Mobile homes are subject to statutory definitions for tax purposes in KRS 132.260 and KRS 132.720 to 132.750. Generally the statutes require that a house trailer shall be classified as real estate if the wheels have been removed and it rests on a permanent, fixed foundation. Otherwise, a house trailer is taxed as tangible personal property unless it is not licensed in Kentucky and does not remain in the state for more than three months out of any twelve month period.

Both multi-family rental units and single family housing could experience rapid price increases if vacancy rates are low. The impact of this effect on elderly and on low income residents could be severe, particularly if displacement occurs in order to charge higher rents. Household characteristics and income levels discussed in the first section of this report provide some insight into what could occur. Female-headed families and others below the median income could find it difficult to compete against construction wage scales for housing.

The housing problem appears to have three components: the potential for overbuilding so that resale after the construction peak is difficult; the potential for piecemeal, scattered development so that municipal types of services are either basically unavailable, or overextended and too costly; and, related to this situation, small scale, custom builders who are inexperienced in the development of larger numbers or a mix of units. Local financial institution and governmental policies and project construction management policies will have a major influence on the resolution of this issue.

Public Services and Financing

Residential choices by the construction work force also determine the impact on public services whether city or county. Methods for predicting the geographic distribution down to the community level are not considered very accurate, especially in light of the uncertainties of timing for energy projects. Estimating the cost of service expansion is another area where the available methods for cost/revenue analysis of either capital or operating expenditures have significant drawbacks. Consequently, local governments in the impact area of a major construction project are at a disadvantage in deciding what facilities and services should be expanded and on what timetable. A related question, as with housing, is short-term versus long-term needs and justification for expenditures. Financing problems, then, are generally acknowledged to be of three types:

- tax lead time in which revenue growth follows inmigration leading to cash flow difficulties
- difficulty in borrowing because of uncertainties associated with projects
- jurisdictional mismatches where a facility cannot be taxed by the locality in which population impacts occur. (The 4 projects in Kentucky are all located in county tax jurisdictions; one of the 4, SRC-I would be tax exempt during its demonstration phase.)

Equity issues also enter into financing of new services. The beneficiaries of the new services would not be a source of revenue when the front end financing for service expansion before the population influx is needed.

The revenue structure of Kentucky local governments described earlier in this report indicates the mechanisms by which financing solutions could occur and assistance be provided.

Green River Area Development District has been assessing municipal service capacities in the impact area as part of its two year study for local officials. The Environmental Impact Statement (EIS) for the H-Coal plant in Breckinridge County will further address the issue there, as will the EIS's for the Tri-State and Grace projects. These will identify the service shortfalls or problems that can be expected.

Labor Supply and Employment

The level of inmigration will be affected by the relative scarcity of skilled labor supply in the 75 mile daily commuting range. Making labor supply estimates by occupation is very difficult. Consequently what is shown here should be used only as an indicator of the scale of labor demand in relation to local supply.

Labor market analysts at the Kentucky Department for Human Resources have attempted to estimate the skilled labor supply in Kentucky. No information for Indiana was readily available. Analysts define the labor supply for any occupation as the number of persons in the occupation plus those persons qualified but not working and available for employment. The estimates by trade were made separately for Breckinridge County and Henderson and Daviess Counties and are shown below.

When skilled labor is involved, it is generally assumed that most of the supply for a new project will come from the working labor force. Though unemployment is high now in the skilled construction trades, the situation when construction begins may well be different. Estimates of peak craft demand for the 4 projects in 1986 now indicate a need for 10,000 pipefitters, 3,000 insulators 1300 millwrights and 1200 boiler makers. While daily commuting from Indiana would meet some of the demand, it still remains clear that weekly commuters and relocators would fill a significant part of the labor force. It also indicates strong competition with the local market for existing skills is possible especially for workers who, with some training, could perform in a craft with supervision. Requirements for an estimated 1700 laborers at peak could also be expected to come from the local market. This competition will cause wage inflation for local businesses and may curtail local construction plans for commercial, industrial or public facilities. It could also affect the ability of local developers to meet housing demand at affordable prices.

The growth in total employment and income in the site counties and adjacent counties is likely to be high during the peak construction years. The local labor force will probably increase and unemployment will drop. Project related employment growth for local labor could occur in local industries supplying material for construction and in the major retail and service centers such as Henderson and Owensboro. For the latter, the impact could be less than expected as weekly and distance commuters tend to spend their money at home or send the bulk of income to families.

Though labor demand on current schedules now peaks in 1986, it does drop to the 12 to 13,000 level in late 1987. This decline in employment levels is the most noted of the boomtown effects. Its effect, the severity of dislocation of the local economic and social structures, is most noted in locations which do not have a diversified economic base; that is, are dependent on a particular industry which cannot sustain the labor force participation or meet the wage rates which were created by construction.

Land Use

Synfuel plant land use for facilities and waste disposal and its impact on cropland has been described in the *Kentucky Synfuel Industry: A Basis for Assessment and Planning*. The population influx for construction will also affect the existing pattern of land use by causing the conversion of more land to urban uses.

Residential development is the most highly variable element of the land requirements. Construction managers for the projects could choose to provide some on site housing as an employment incentive. The weekly commuter and even the relocating worker will frequently bring his own mobile home or RV to an area. Occupancy levels in existing rental units can vary from 1 to 3 or 4 workers.

Other factors controlling land requirements are local regulatory policies governing items such as number of units per acre, roads, rights of way and the mix of single family and rental units. These are established through the zoning ordinance and subdivision regulations. As was noted in Table 24 zoning and subdivision regulations are now used countywide in Daviess, Hancock, Henderson, and Union Counties except Uniontown and Hawesville lack zoning. Breckinridge and Meade are the only counties without a comprehensive plan though some of the other county plans need updating. The land use element and objectives of a comprehensive land use plan, the first requirement for planning and zoning, are the legal basis for zoning under state law (KRS 100). It is through zoning, for example, that placement of mobile homes is controlled and flood plain protection is provided. Subdivision regulations require the entire comprehensive plan. Cities tend to be the chief users of subdivision regulation but most counties have not granted extraterritorial jurisdiction which allows regulation of territory five miles beyond the city limits. These factors will have a significant effect on urban development.

The addition of new residential areas could also mean an expansion of shopping centers and light commercial areas. Scattered development could lead to numerous small centers. Usually retail and commercial growth has a lag period or slower response to growth in the local service sector. The temporary nature of the construction work force may also reduce growth. But in this area as well as residential, many of the controlling decisions on land use can be made by the cities and counties through the planning and zoning process.

Cultural Change

When large numbers of newcomers move into an area and are a transient work force, social relationships change. The newcomers may have different traditions and values causing social and political conflict. The western boom towns have been characterized by rising crime rates, increases in divorce rates, alcoholism and other mental health problems. These are said to stem from the acute housing shortages and service shortfalls that cause a breakdown in community structures and poor quality of life. Everyone feels increased stress. The boom town effect, however, is also tied to a very rural and isolated setting. John Gilmore described a typical boom town in a 1976 article:

"Pistol Shot is 100 miles from a town of as many as 10,000 or 15,000 people; it is more than 200 miles from a metropolitan area. Thus it has to depend on its own resources and cannot borrow consumer services from other places.... Its population in 1970 was 1200....

Population in Pistol Shot has nearly tripled since 1970 and is accommodated by mobile homes sprawled over the countryside. The rapid influx of people has generated population growth rates of around 25 percent; in most boomtowns a 15 percent growth rate leads to institutional breakdowns in the labor market, the housing market, and the system for financing local public facilities. Education, health services, and housing are far behind demand...." (*Science*, Vol. I, p.535-40, Feb. 13, 1976)

The issues seen in Pistol Shot are similar but the carrying capacity of an urbanized area such as West Kentucky - its ability to absorb a population influx - is much greater. The ability to manage growth, to identify the issues and develop solutions, is greater. A community's attitude toward the energy development process is often the key factor in its ability to adapt to change and mold its direction.

PROJECT OPERATIONS AND COAL PRODUCTION ISSUES

As construction phases down in 1988 and 1989, both coal demand and operating labor begin to phase in. These two factors are the source of the permanent impacts of the proposed projects. Coal demand will shift the location of impact to the major coal producing counties in the region; Muhlenberg, Hopkins, Ohio and Union.

Coal demand begins with stockpiling of coal prior to start up of the first plant in late 1985. A KDOE report estimating future coal production in West Kentucky describes the situation as follows:

"The synfuels-related coal demand increases slowly until the last half of 1987 when the H-Coal and Grace projects begin coal aquisition for inventories. From that point, demand rises sharply. Between 1987 and 1990 synfuels-related demand moves from 2 million to 30 million tons per year. Some slippage in project schedules is expected and would result in a more moderate rate of increase in coal demand. Such slippage is desirable from one point of view. Increases in production within a region are limited by the time required to develop support services and new production capacity. A greater portion of demand could be met from the local region, i.e., West Kentucky, if that region had the time necessary to develop the required level of mining capacity, service industries, and public services.

Specifications for the coal used in the West Kentucky synthetic fuel plants is met by the Kentucky no. 9 seam, the most abundant seam in West Kentucky. However, other coals in the Illinois Basin also meet these specifications and thus it is unlikely that all of the coal required for the synfuels plants will be mined in West Kentucky. What this percentage will be is not easily determined."*

If West Kentucky captures 91% of the synfuels market, considered an outside margin, and maintains its market share of other coal demand, total coal demand to 1995 would grow from 42,449,000 tons in 1979 to 106,723,000 tons in 1995.

*David Holmes, KDoE, Sept. 1981.

Labor Supply: Operations

Should all four plants be built, an estimated 8,000 permanent jobs in operations and maintenance would be created to run the plants. The first permanent jobs would begin in late 1985 on current schedules; build rapidly from 3,000 to 6,000 jobs between 1987 and 1989, and stablilize at the 8,000 level in 1991. The Tri-State project alone accounts for 3,000 of the jobs as well as 2.5 million tons of coal per quarter by 1990.

The permanent plant labor force would have a more significant long term effect on the local and regional economy. A large percentage is likely to come from the local labor force within perhaps a 50 mile commuting distance. On-the-job training would be provided enabling less skilled local labor to qualify. Again there could be shifts in local employment patterns with workers leaving existing jobs to work at the synfuels plants. This would open existing jobs to new entrants in the labor force.

The secondary or induced employment in trade and services and in industries supplying material or support services to the synfuels plants would be long term. Expansion of the labor force and some in-migration can be expected; however, the distribution could be more evenly spread among the site counties and their labor market areas. These areas are represented by the commuting figures on page

Mining

Mining employment in the West Kentucky coal fields increased by about 4,000 jobs between 1974 and 1976 according to the annual reports of the Kentucky Division of Unemployment Insurance. The Division's records combine mining and quarrying but over 90% of the jobs covered are in the coal industry. From 1976 employment has remained in the 12,000 plus range. Special reports for coal mining only have been prepared since 1979. In 1979, the average employment was 11,922. Coal mining unemployment was 593 in February 1980; 681 in February 1981 in Western Kentucky. There does not appear to be a large pool of unemployed miners now in West Kentucky to be absorbed by industry expansion. However, unemployed miners who have taken other jobs could shift back to mining if demand rises. Knowledgeable observers of the coal industry today estimate excess production capacity of 25 million tons in the Illinois Coal Basin alone.

The Kentucky synfuels industry is expected to create about 7,000 additional jobs in mining for the Illinois Basin. The portion of that increase occurring in Kentucky depends on the percentage of coal provided by Kentucky mines. As noted earlier, the outside margin estimated by the Kentucky Department of Energy is 91%. A more likely range is from 70% to 80% of the total 40 million tons per year or 21 to 24 million tons annually and approximately 5,000 new jobs.

This increase would probably occur in the major producing counties of Muhlenberg, Hopkins, Ohio and Union at first. The number of jobs to be filled from the area labor force and how many by in-migrants is unknown. Employment growth during the coal boom period between 1974 - 76 indicates that the area could absorb a population influx without undue strain. Population growth in Hopkins and Muhlenberg counties between 1970 and 1980 ranged from 21% to 17% and in Ohio, 16%. Only Union fell below the state average of 13.7%. Hopkins' population alone grew by 8,000 people.

The rapidity of any influx to any particular county is difficult to predict since it is not known where expansion in production would occur.

SEAM, the Social and Economic Assessment Model developed by Argonne National Laboratory, has been applied in a study of 200 counties where new or expanded mining activity was expected to meet National Energy Plan coal production levels to 1985. These counties were selected from the four major coal regions including the mid-west. In a report on the results public cost estimates were described as surprisingly low and related to "the fact that coal mining, which is not a labor intensive activity, does not generally create high levels of local effect."

Land Use

The major shifts in land use from plant operations and coal mining have been estimated in the KDOE report, *A Basis for Assessment and Planning* as follows:

"The mining of additional coal for the synfuel plants could result in significant land disturbance. An estimate for 40 million tons of coal assuming 50% is from surface mining is 4,000 acres disturbed per year (based on 1800 tons of coal/acre-foot, 45 inch seams, and 80% recovery and adding 10% for additional disturbances: haul roads, prep plants, etc.). Some of the coal is under agricultural lands. The new surface mining laws do not allow farmland to be disturbed unless it can be returned to equal quality for its original use. The technology for reclaiming farmland is well developed and is being applied throughout the Illinois Coal Basin. Continued diligence in this area is needed.

A significant population growth will be associated with both the construction and operational phases of the synfuels industry. This population growth may contribute to some urban sprawl and the conversion of additional farmland. The estimates for the maximum additional urban area needed in 1990-92 are: 3,300-5,000 acres resulting from plant operation and 3,800-7,600 acres resulting from coal mining (based on 2,682 persons/square mile in Kentucky urban-suburban areas)."

Kentucky would probably provide between 70 and 80% of the 40 million ton annual coal demand. If current production patterns continue slightly over half of the coal supply would come from surface rather than underground mines. However, discussions with project developers have indicated that most of the coal needs for synfuels may come from large dedicated underground mines.

Coal resources are usually measured in tons but the U.S. Soil Conservation Service has provided a measure for surface mining reserves by county in acres and related it to prime farmland acreage.

Two counties, Muhlenberg and Hopkins, appear to have the largest amounts of high yield, including prime farmlands that could be affected by strip mining as shown in Table 30.

Remaining surface mineable coal resources in the 11 counties have been estimated using 28 inch or better seams and 150 or less feet of overburden (Table 31). Hopkins and Muhlenberg Counties have the highest estimated resource base followed by Daviess and Ohio. Hopkins County also contains the largest total coal resource at 7.9 billion tons followed by Henderson and Union at 6 billion and McLean and Muhlenberg at 3 billion (Table 2). Hopkins, Union and Muhlenberg are now in the 40% range in lands used for farming. Hopkins exceeds Daviess in land converted to urban use while Ohio is third.

This distribution of land use and coal resources suggests also where the shifts in land use may occur for both coal production and urban land to house and provide services to miners in the future. The reclamation policies and abandoned mine lands program under the federal surface mining law could have an offsetting effect as lands are returned to productive use over the next decade.

IMPACT MANAGEMENT

Clearly a rapid rate of change would occur in these 11 counties of western Kentucky if the four synfuel projects are built. The projects would accelerate the industrialization of an area already having a significant manufacturing base. They would increase mining activity; they would bring more people to work and live in the area. Communities and counties which have perceived themselves as agricultural and rural in lifestyle would experience a shift in emphasis in the economic and social structures to which they have become accustomed.

Western state experiences have shown that early planning for impact management is essential to prevent the pace of change from overtaking the capacity of an area to absorb and adjust. This report has been written as part of the state's continuing assessment to prepare for impact management. Unlike other impact studies, either environmental impact statements or project sponsored assessments, this report frames the issues as cumulative socioeconomic changes from all four projects. While it cannot provide quantitative estimates of impact on local housing, schools or services, it does identify specific areas of concern and a profile of existing conditions. The Kentucky Department of Energy (KDOE) hopes that this report and others to follow will serve both state and local planners and citizens in efforts to identify specific issues and direct resources to their resolution.

The state's impact management effort goes beyond this broad educational effort. KDOE is the coordinating agent of the state's Synthetic Fuels Technical Committee. This group, made up of representatives of each Secretary of the state's Cabinet has been working since January on an assessment of the cumulative synfuel impacts on state programs and services.

This includes health and environmental services, elementary, secondary and vocational education, transportation and community development, housing and economic impacts. The Committee's work will be periodically updated as new, more refined data on labor demand and supply and construction schedules become available.

The synfuels/power plant population update prepared in July 1981, is the basis of the state's assessment. As with any estimates prepared several years in advance of events, the population projections use assumptions about relocation and migration that will change over time. They will be reviewed for each semi-annual update.

The population projections are also being used by the Green River and Lincoln Trail Area Development Districts for their local impact planning. The ADD planners are ad hoc members of the Technical Committee.

KDOE provides the coordinating and information sharing role between the project sponsors and the Committee as well.

The state of Kentucky's efforts to plan for impact management will be a continuing process. It will necessarily involve a cooperative partnership among the local governments, the state, and the project sponsors.

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Table 1

Mineral, Gas and Oil Production
June 1, 1980 - December 31, 1980
11 Counties

County	Other Minerals (tons)	Oil (barrels)	Natural Gas (mcf)
Breckinridge	166,492	2,693	
Daviess	1,119,526	241,987	61,575
Hancock	66,143	41,211	11,794
Henderson	137,612	475,099	19,815
Hopkins		143,437	653,107
McLean	19,854	195,225	46,682
Meade	837,788		
Muhlenberg	386,919	375,057	96,578
Ohio	304,508	98,611	25,172
Union	51,638	441,554	936
Webster		188,434	24,033
TOTAL	**3,090,480**	**2,203,306**	**939,692**
STATE	*26,742,541*	*3,610,414*	*35,018,447*

Source: Kentucky Department of Revenue, Administrative Compliance Division.

Total W.Ky. Coal Field	*40,989,298*	*2,362,731*	*38,626,526*

Table 2

Western Kentucky Coal Resources*
Within 11 Counties
(million tons)

County	Totals	Mined & Lost	Remaining
Breckinridge	268	0	268
Daviess	1,330,323	22,500	1,307,823
Hancock	170,276	2,702	167,574
Henderson	6,852,765	32,114	6,820,651
Hopkins	8,814,801	879,702	7,935,099
McLean	3,576,413	22,876	3,553,537
Muhlenberg	4,723,837	981,488	3,742,349
Ohio	1,824,572	220,545	1,604,027
Union	6,506,974	124,460	6,382,514
Webster	6,322,849	58,184	6,264,665
TOTAL	**40,123,078**	**2,344,571**	**37,978,507**
Total W.Ky. Coal Field	*40,989,298*	*2,362,731*	*38,626,526*

*As of January, 1976 - Reserves are some fraction of the resource base.

Source: *Western Kentucky Coal Resources*, Kentucky Geological Survey, September, 1978, G.E. Smith & R.A. Brandt.

Table 3

1979 Production Levels - Leading Cash Products

County	No. of Beef Cows	Bushels of Soybeans	Bushels of Corn	lbs of Tobacco	Bushels of Winter Wheat
Breckinridge	27,500^{1*}	697,500	3,493,600	4,250,000	205,000
Daviess	12,600	3,104,000^{1}	5,400,000^{4}	5,265,000	221,400
Hancock	3,500	467,000	423,000	1,360,000	54,600
Henderson	9,500	3,102,000^{2}	7,280,000^{2}	552,000	446,200
Hopkins	6,500	1,376,000	2,943,200	138,000	96,100
McLean	3,500	2,065,000	2,948,400	1,260,000	156,000
Meade	10,900	384,000	1,368,000	1,120,000	154,000
Muhlenberg	7,900	930,000	1,352,400	702,000	63,000
Ohio	10,000	840,000	2,808,000	1,610,000	26,400
Union	12,900	1,540,000	7,308,000^{1}	-	424,200
Webster	6,900	1,600,000	4,704,000^{5}	119,000	220,400
TOTAL	**111,700**	**16,096,500**	**40,028,600**	**16,376,000**	**2,067,500**
STATE	*1,106,000*	*53,950,000*	*132,600,000*	*312,000,000*	*11,020,000*

*superscript shows that county's production rank in state

Source: "Kentucky Agricultural Statistics, 1979-1980." Kentucky Crop and Livestock Reporting Service, USDA and Kentucky Department of Agriculture.

Table 4

Cash Receipts from Farm Marketing - County Estimates (1000 Dollars)

County	Livestock	Crop	All Cash Receipts
Breckinridge	$ 17,195	$ 15,738	$ 32,933
Daviess	17,324	38,221	55,545
Hancock	2,177	6,979	9,156
Henderson	8,892	28,301	37,193
Hopkins	5,635	13,080	18,715
McLean	4,312	19,850	24,162
Meade	9,525	6,043	15,568
Muhlenberg	6,820	10,437	17,257
Ohio	6,045	13,666	19,711
Union	23,464	19,147	42,611
Webster	7,075	16,822	23,897
TOTAL	**117,464**	**188,284**	**287,977**
STATE	*999,796*	*1,040,131*	*2,039,927*

Source: *Kentucky Agricultural Statistics, 1979 - 1980.* Kentucky Crop and Livestock Reporting Service, USDA and Kentucky Department of Agriculture.

Table 5

1979 West Kentucky Coal Production within 9 Coal Producing Counties

County	Tons
Daviess	1,025,191
Hancock	834
Henderson	617,947
Hopkins	7,800,089
McLean	64,010
Muhlenberg	12,218,134
Ohio	9,870,512
Union	5,845,475
Webster	3,960,647
TOTAL	**41,402,839**

Source: 1979 Annual Report, Kentucky Department of Mines and Minerals.

Table 6

Total Wages Covered by Kentucky Unemployment Insurance Law Calendar Year 1979

11 Counties

County	Mining and Quarrying	Manufacturing	Wholesale & Retail Trade	Services*
Breckinridge	$ 362,194	$ 2,801,263	$ 3,953,929	$ 6,596,442
Daviess	14,391,892	103,342,201	63,448,036	78,266,623
Hancock	128,987	65,084,113	1,004,850	3,484,998
Henderson	8,121,869	66,593,621	27,361,694	38,196,371
Hopkins	60,605,282	44,493,547	27,327,683	46,727,367
McLean	761,486	3,101,478	3,352,024	3,865,002
Meade	-	-	2,935,441	5,231,236
Muhlenberg	79,322,985	6,421,525	15,128,638	15,780,891
Ohio	57,830,975	9,794,175	5,603,898	10,259,427
Union	65,470,990	7,128,956	7,038,323	15,768,859
Webster	22,866,626	313,357,466	161,578,354	231,960,916
TOTAL	**309,863,286**	**313,357,466**	**161,578,354**	**231,960,916**
STATE	*1,146,200,970*	*4,398,779,641*	*2,401,184,359*	*3,369,005,907*

*Effective 1/1/79, the Kentucky Unemployment Insurance Law extended coverage to include all state and local government agencies

Source: Kentucky Department for Human Resources, Division of Unemployment Insurance.

Table 7

Comparison of Covered Employment Levels in Mining and Manufacturing for 1976 and 1979

	Manufacturing			Mining & Quarrying		
County	1976	1979	% Change	1976	1979	% Change
Breckinridge	324	287	-11	41	38	-
Daviess	6,810	6,816	-	545	812	49
Hancock	2,633	2,876	9	34	13	-6
Henderson	3,914	4,749	21	475	474	-
Hopkins	3,581	3,393	-5	2,547	2,583	1
McLean	444	317	-28	113	45	6
Meade	597	773	29	-	-	-
Muhlenberg	694	698	-	3,575	3,175	-11
Ohio	1,024	998	-17	2,293	2,343	2
Union	464	789	70	1,909	2,700	41
Webster	455	465	2	849	926	9
TOTAL	21,120	22,161	5	12,381	13,071	5

Source: Annual Reports, Kentucky Department for Human Resources, Division of Unemployment Insurance.

Table 8

Annual Average Unemployment Rates by Place of Residence

County	1976	1977	1978	1979	1980
Breckinridge	5.0	4.1	5.1	6.8	8.2
Daviess	6.8	4.8	5.1	5.6	7.4
Hancock	5.6	4.0	5.3	6.3	6.7
Henderson	5.4	4.7	5.5	5.2	6.7
Hopkins	3.1	3.0	3.0	5.8	7.1
McLean	5.1	5.1	5.6	6.4	8.7
Meade	5.6	4.7	6.6	7.1	8.6
Muhlenberg	4.2	4.1	5.4	5.5	8.9
Ohio	3.8	3.9	4.1	4.3	8.4
Union	2.9	3.5	3.1	3.4	4.1
Webster	4.5	4.1	4.1	4.3	7.1
STATE AVERAGE	5.6	4.7	5.2	5.6	8.1

Source: Kentucky Labor Force Estimates, Department for Human Resources Bureau for Manpower Services.

Table 9

1979 Employment by Major Industry

		Covered Employment by Place of Work[1]				
County	Agriculture (by residence)[2]	Employment All Industries (8 categories)	Manufacturing	Mining & Quarrying	Wholesale & Retail Trade	Services
Breckinridge	1,112	2,057	287	3	566	761
Daviess	1,332	29,371	6,816	812	7,315	8,485
Hancock	192	4,190	2,876	13	158	390
Henderson	636	14,212	4,749	474	3,215	3,829
Hopkins	485	16,395	3,393	2,583	2,940	4,858
McLean	473	1,320	317	-	385	446
Meade	289	2,223	773	-	445	1,414
Muhlenberg	388	8,270	698	3,175	1,655	1,742
Ohio	537	5,833	998	2,343	753	1,185
Union	616	6,716	789	3,700	872	1,829
Webster	421	3,756	465	926	583	843
TOTAL	**6,481**	**94,343**	**22,161**	**11,944**	**18,442**	**24,368**
STATE	**73,049**	**608,560**	**296,898**	**48,884**	**268,707**	**339,853**

1 Covered employment data represents all workers "covered" under Kentucky's Unemployment Insurance Law. The "-" indicates non-disclosure under the terms of the law administered by the Kentucky Department for Human Resources (DHR). The Bureau of Manpower Services, DHR, makes estimates of agricultural employment as these workers are not "covered."

Source: Kentucky Economic Statistics, 1979-80, Kentucky Commerce Cabinet.

Table 10

Retail Sales in Relation to Effective Buying Income (EBI) by County (1979)

County	Total EBI	Total Retail Sales	% of EBI
Breckinridge	$ 90,885	$ 43,190	48
Daviess	572,251	391,507	68
Hancock	49,855	9,829	20
Henderson	277,232	169,434	61
Hopkins	342,515	172,843	50
McLean	60,467	22,825	38
Meade	93,614	31,392	34
Muhlenberg	245,157	127,729	52
Ohio	149,702	56,866	38
Union	104,410	44,140	42
Webster	86,342	33,998	39

Source: *Kentucky Economic Statistics, 1979 - 1980*, Kentucky Commerce Cabinet.

Table 11

Civilian Labor Force* by Place of Residence

County	1976	1977	1978	1979	1980	% Change 76 - 80
Breckinridge	6,717	6,934	6,738	6,570	6,625	-1
Daviess	35,505	37,030	37,396	37,927	42,171	18
Hancock	3,154	3,232	3,374	3,540	3,711	18
Henderson	15,578	16,097	17,194	18,582	19,337	24
Hopkins	20,928	22,442	21,912	21,895	21,859	4
McLean	5,551	5,015	4,719	4,614	4,909	-12
Meade	5,210	5,473	5,891	6,090	6,456	24
Muhlenberg	12,382	12,800	13,161	13,250	13,673	10
Ohio	11,879	12,244	12,481	12,331	12,442	5
Union	7,185	7,649	8,042	8,406	9,305	30
Webster	5,447	5,709	6,458	6,738	6,908	27
TOTAL	**129,536**	**134,625**	**137,366**	**139,943**	**147,396**	14
STATE	**1,451,000**	**1,517,000**	**1,551,000**	**1,563,000**	**1,621,000**	12

*Labor force data generally are derived from a Bureau of Labor Statistics methodology which is subject to a wide range of error at the county level.

Source: "Kentucky Labor Force Estimates," Department for Human Resources, Bureau for Manpower Services.

Table 12

Covered Average Weekly Wages by Place of Work: 1979

County	Manufacturing	Mining & Quarrying	Trade	Services
Breckinridge	$187.87	$181.29	$134.44	$166.62
Daviess	291.57	340.98	166.81	177.38
Hancock	435.21	194.55	122.30	172.03
Henderson	269.68	329.69	163.66	191.84
Hopkins	252.16	451.29	178.75	154.35
McLean	-	187.90	167.65	166.84
Meade	-	233.64	145.80	165.75
Muhlenberg	176.94	480.48	175.77	174.21
Ohio	188.74	-	143.05	166.47
Union	173.76	466.32	155.22	165.82
Webster	190.00	474.72	145.99	177.72
STATE	**284.92**	**406.26**	**171.85**	**190.64**

"-" indicates non-disclosure under Kentucky Unemployment Insurance Law.

Source: "Kentucky Economic Statistics," 1979-1980, Kentucky Commerce Cabinet.

Table 13

Estimated 1979 County Labor Force by Sex

County	Civilian Labor Force	Male	% Unemployed	Female	% Unemployed
Breckinridge	6,570	3,896	6.0	2,674	8.0
Daviess	37,927	22,491	4.9	15,436	6.6
Hancock	3,540	2,099	5.5	1,441	7.4
Henderson	18,582	11,019	4.6	7,563	6.1
Hopkins	21,895	12,984	5.1	8,911	6.9
McLean	4,614	2,736	5.6	1,878	7.6
Meade	6,090	3,611	6.2	2,479	8.4
Muhlenberg	13,250	7,857	4.8	5,393	6.4
Ohio	12,331	7,312	3.8	5,019	5.1
Union	8,406	4,985	3.0	3,421	4.1
Webster	6,738	3,996	3.8	2,742	5.1
TOTAL		**82,986**		**56,957**	

Source: "Kentucky Total and Non-White Population and Labor Force Data by County," July 1980, Kentucky Department for Human Resources, Bureau of Manpower Services.

Table 14

Educational Levels of Males and Females 25 Years and Older 1970 Census

County	No. Males	Median Years Completed	% High School Graduates	No. Females	Median	%
Breckinridge	4,057	8.5	23.0	4,197	8.9	29.8
Daviess	19,138	11.5	46.9	22,151	12.0	50.6
Hancock	1,939	9.4	38.3	1,808	10.2	39.5
Henderson	9,247	10.8	43.7	10,548	11.2	44.6
Hopkins	10,312	9.0	34.7	11,888	9.8	36.2
McLean	2,567	8.8	29.8	2,779	9.4	34.1
Meade	4,343	12.1	52.2	4,138	12.0	51.0
Muhlenberg	7,574	8.8	30.0	8,488	9.2	31.5
Ohio	5,321	8.7	28.4	5,609	8.9	28.3
Union	3,602	10.6	40.9	4,080	11.3	45.6
Webster	3,717	8.8	28.7	4,367	9.3	36.5
STATE	**808,995**	**9.5**	**NA**	**904,303**	**10.3**	**NA**

Source: U.S. Census, 1970, PC1-C19.

Table 15

Population Changes

County	1970	1980	% 70-80 Change	1981 Projections 1985	1981 Projections 1990
Breckinridge	14,789	16,861	14.0	17,560	18,265
Daviess	79,486	85,949	8.1	89,620	93,327
Hancock	7,080	7,742	9.4	7,987	8,248
Henderson	36,031	40,849	13.4	43,104	45,391
Hopkins	38,167	46,174	21.0	50,069	54,153
McLean	9,062	10,090	11.3	10,962	11,844
Meade	18,796	22,854	21.6	24,647	26,511
Muhlenberg	27,537	32,238	17.1	33,198	34,102
Ohio	18,790	21,765	15.8	23,350	24,984
Union	15,882	17,821	12.2	18,636	19,513
Webster	13,282	14,832	11.7	15,643	16,528
TOTAL STATE	**3,220,711**	**3,661,433**	**13.7**	**3,860,306**	**4,061,474**

Source: State Data Center, University of Louisville, Urban Studies Center **1980 Final Counts** and "How Many Kentuckians, The 1981 Update," University of Louisville, Urban Studies Center.

Note: The 1981 Update of the Population Projections accounts only for normal growth without synfuel projects.

Table 16

Population Distribution by Age Group
1979 Estimates for 1980

County	0-19	% of Total	20 - 64	% of Total	65+	% of Total
Breckinridge	5,254	33	8,682	53	2,175	14
Daviess	28,478	35	44,950	54	8,660	11
Hancock	2,626	35	3,929	53	851	12
Henderson	13,157	33	21,359	55	4,609	12
Hopkins	14,993	32	25,708	55	6,112	13
McLean	3,434	31	6,070	55	1,507	14
Meade	8,446	39	12,116	55	1,254	6
Muhlenberg	10,330	32	17,592	54	4,398	14
Ohio	7,143	32	12,125	54	3,164	14
Union	7,581	41	9,074	49	1,916	10
Webster	4,812	31	8,371	53	2,501	16
STATE	**1,175,244**	**33**	**1,990,836**	**56**	**401,264**	**11**

Source: "How Many Kentuckians: Population Forecasts, 1970-2000, The 1979 Update," University of Louisville, Urban Studies Center.

Table 17

Projected School Enrollment

School District	Enrollment 1980-81	Enrollment 1985-86	% Change
Breckinridge County	2,995	2,739	-9
Cloverport Ind.	376	324	-14
Daviess County	10,321	9,209	-11
Owensboro Ind.	7,767	6,431	-17
Hancock County	1,827	1,689	8
Henderson County	8,375	7,855	6
Hopkins County	8,592	8,076	6
Dawson Springs Ind.			
McLean County	2,003	1,748	-13
Meade County	3,671	3,531	-4
Muhlenberg County	4,892	4,834	-
Central City Ind.			
Greenville Ind.			
Ohio County	4,552	4,442	2
Union County	3,479	3,324	-4
Webster County	2,369	2,378	-
Providence Ind.	785	759	-3

Ind. - independent school district.

Source: State Department of Education, Division of Research and Statistics.

Table 18

1978 Household Characteristics

	Family Households			Non-Family Households			Total Households by Age Distribution			
County	Husband/ Wife	Male Head	Female Head	Male	Female	Total No. of Households	17-24	25-44	45-64	65+
Breckinridge	3,783	172	427	457	627	5,466	395	1,819	1,737	1,515
Daviess	18,295	623	3,021	2,370	4,290	28,599	2,909	10,574	9,528	5,588
Hancock	1,764	54	173	235	207	2,433	232	893	718	590
Henderson	8,848	294	1,526	1,227	1,836	13,731	1,219	4,978	4,462	3,072
Hopkins	10,818	417	1,615	1,133	2,525	16,508	1,304	5,997	4,970	4,237
McLean	2,765	95	292	224	476	3,852	281	1,397	1,120	1,054
Meade	5,441	172	453	536	388	6,990	1,184	3,472	1,522	812
Muhlenberg	7,689	264	985	674	1,469	11,081	806	3,729	3,538	3,007
Ohio	5,394	198	628	534	870	7,619	553	2,693	2,271	2,162
Union	3,559	120	505	444	786	5,414	444	1,909	1,714	1,347
Webster	3,625	146	440	367	886	5,464	329	1,669	1,667	1,789

Source: "1980 Housing Report for Kentucky," University of Louisville, Urban Studies Center.

Table 19

Per Capita Income by Place of Residence

County	1974	1979	% Change
Breckinridge	$ 3,762	$ 5,855	55
Daviess	4,954	8,412	70
Hancock	4,189	6,976	66
Henderson	4,963	8,616	74
Hopkins	5,694	9,155	61
McLean	4,138	6,765	63
Meade	3,341	5,086	52
Muhlenberg	4,456	7,939	78
Ohio	4,216	6,962	65
Union	4,288	7,285	70
Webster	4,621	8,238	78
STATE	**4,524**	**7,377**	**63**

Source: Kentucky Economic Information System, (Bureau for Economic Analysis, U.S. Department of Commerce), Kentucky Council for Economic Advisors, University of Kentucky.

Table 20

Estimated Number of Individuals Below Poverty Level: 1978

County	Absolute Poverty (Number)	Relative Poverty (%)
Breckinridge	4,564	29.84
Daviess	13,112	16.24
Hancock	1,414	19.18
Henderson	6,151	16.79
Hopkins	6,866	16.07
McLean	1,946	19.21
Meade	4,711	25.55
Muhlenberg	6,772	22.41
Ohio	4,607	22.53
Union	3,868	23.26
Webster	2,925	20.54
STATE	*766,354*	*22.62*

Source: *Kentucky Economic Statistics, 1980*, Kentucky Commerce Cabinet.

Table 21

1979 Median Family Income

County	Amount[1]	No. of Low Income Families[2]	% of Total No. of Families
Breckinridge	$ 11,500	1,790	38.0
Daviess	16,400	8,390	37.9
Hancock	15,400	550	26.8
Henderson	15,500	5,310	48.5
Hopkins	13,200	4,550	34.7
McLean	11,200	1,350	41.6
Meade	14,000	1,800	28.4
Muhlenberg	12,300	3,580	39.1
Ohio	11,400	2,750	42.7
Union	14,700	1,310	30.4
Webster	11,100	1,820	42.3
STATE	*13,700*	*386,900*	*40.0*

1 Source: U.S. Department of Housing and Urban Development (HUD), Office of Policy Development and Research. The definition of income is total money income before tax and other withholding.

2 Low income families have incomes below 80% of the median family income. These numbers are based on HUD income distributions but were developed by the University of Louisville, Urban Studies Center for the 1980 Housing Report.

Table 22

Acreage Converted to Urban Land Use

County	Total Acreage	Acres in Urban Use			% of Total
		1958	1967	1977	
Breckinridge	360,960	7,991	8,160	9,214	2
Daviess	295,680	14,022	14,275	18,450	6
Hancock	119,680	14,022	14,275	18,450	6
Henderson	277,120	9,248	9,246	14,000	5
Hopkins	353,920	11,832	12,898	21,942	6
McLean	164,480	4,198	4,207	5,200	3
Meade	195,200	4,273	4,791	8,600	4
Muhlenberg	307,840	5,787	6,284	7,540	2
Ohio	381,440	10,860	12,411	16,000	4
Union	217,600	6,166	6,427	15,330	5
Webster	216,960	5,635	5,907	8,028	4

Source: Kentucky Soil and Water Conservation Needs Inventory, 1970 and soon to be published, 1980. U.S. Soil Conservation Source, Lexington, Ky.

Table 23
Current Land Use Controls

	Type Commission	Covered by Approv. Comp. Plan	Approv. Zoning Ordinance	Approv. Subdiv. Regs.
Breckinridge	No	No	No	No
Cloverport	City	Policies, Goals, Objectives	Yes	No
Hardinsburg*	No (under study)			
Irvington	No	None currently	1975	No
Daviess County	Joint City & County	Yes	Countywide	Countywide
Owensboro*		Yes	Citywide	Citywide
Whitesville		Yes	Citywide	Citywide
Hancock County	Joint City & County	Yes	1979**	1979
Lewisport		Yes	Citywide '79	1979
Hawesville*		Yes	1979	
Henderson County	Joint City & County	Yes	Countywide (interim) '72	Countywide '78
Corydon		Yes		
Henderson		Yes	Citywide '72	Citywide '78
Hopkins	Joint City & County	Yes	No	Yes (up to city limits)
Dawson Springs	City	1971-72 Reg. Updated	Yes	Yes
Earlington	City		No	No
Madisonville	City		Yes	Yes
Mortons Gap	City		No	No
Nebo	No		No	No
Nortonville	City		No	Yes
Saint Charles	No		No	No
White Plains	No		No	No
Meade	No	No	No	No
Brandenburgh	City	Yes	Yes	Yes
Muldraugh	City	1970	Yes	No
McLean County	Joint City & County	Yes	No	Countwide '77
Calhoun		Yes	1975	—
Island		Yes	No	No
Livermore		Yes	City	—
Sacramento	***	No	No	No
Beech Grove	***	No	No	No

Muhlenburg	County	1967	No	No
Bremen	No			
Central City***	City		Interim Yes	Yes
Drakesboro	City		Yes	No
Greenville***	City		Yes	Yes
Powderly	City		Yes	No
So. Carrollton	No		No	No
Ohio County	Joint City & County	Yes	1979	1979
Beaver Dam		Yes	1979	1979
Centertown	***	No	No	No
Fordsville	***	No	No	No
Hartford*		Yes	1979	1979
McHenry	***	No	No	No
Rockport	***	No	No	No
Union County	Joint City & County	Yes	1979	1979
Morganfield		Yes	1979	1979
Sturgis		Yes	1979	1979
Uniontown		Yes	No	1979
Waverly		Yes	1979	1979
Webster County	Joint City & County	Yes	No	No
Clay		Yes	1976	No
Dixon*		Yes	No	No
Providence		Yes	1969	No
Sebree		Yes	1976	No
Slaughters	***	Yes	No	No
Wheatcroft	***	Yes	No	No

*County Seat

**Extraterritorial Jurisdiction

***Does Not Participate

Table 24
Estimated Adequacy of Brecinridge County Water, Sewer, and Solid Waste Systems

		Water		Sewer		Solid Waste	
City	County	Present	Future	Present	Future	Present	Future
Muldraugh	Meade	A	A	A	A	A	Q
Flaherty	Meade	A	I	None	-	Q	I
Ekron	Meade	A	I	None	-	Q	I
Doe Valley	Meade	A	A	A	A	Q	I
Brandenburg	Meade	A	Q	A	A	Q	I
Irvington	Breckinridge	A	A	None	-	Q	I
Hardinsburg	Breckinridge	A	A	Q*	A	Q	Q
Kingswood	Breckinridge	A	A	None	-	Q	Q
Westview	Breckinridge	A	A	None	-	Q	Q
Cloverport	Breckinridge	Q	A	A	A	Q	Q
Hawesville	Hancock	A	A	A	A	A	A
Lewisport	Hancock	A	A	A	A	A	A
Tell City	Perry	A	A	A	A	A	A
Cannelton	Perry						

Note: The Lincoln Trail Area Development District advises that planners closely follow the status of Hardinsburg's provisional moratorium on new sewer hookups. The Health Department, in 1974, placed a moratorium on new hookups because of encroachment on effluent BOD standards. The moratorium was eased in during mid-1979 to permit a limited number (about 30) of new hookups. A few additions continue to be allowed (from single family units), but housing development is clearly hindered at the present time.

A - Adequate
Q - Questionable
I - Inadequate

Table 25
School District Tax Base

School District	1980 Tax Rate	1980 Assessed Value	Bonding Capacity	Rank in State/Assessed Value per Child, 1979-80	Local Financial Index[1]	Percent Deviation from State Average Index of .605
Breckinridge County	14.6	$217,540,028	-	53/76,229	.252	-58.35
Cloverport Ind.	29.1	11,929,780	65,000		.614	1.49
Daviess County	22.1	950,416,730	1,300,000	13/97,323	.413	-31.74
Owensboro. Ind.	48.6	506,420,240	-	28/85,970	.703	16.20
Hancock County	23.6	147,223,759	750,000	52/76,407	.738	21.98
Henderson County	27.9	765,298,140	4,400,000	18/92,350	.426	-29.59
Hopkins County	33.2	806,341,299	2,400,000 (committed)	33/84,734	.379	-37.36
Dawson Springs Ind.	50.8	32,589,587	-	154/36,917	.580	- 4.13
McLean County	13.3	171,864,900	-	47/79,307	.171	-71.74
Meade County	24.2	217,354,219	-		.476	-21.32
Muhlenberg County	7.3	420,418,697	2,700,000	26/88,503	.115	-80.99
Central City Ind.	24.5	33,909,300	650,000	152/37,611	.253	-58.18
Greenville Ind.	27.5	90,511,690	-	17/93,498	.296	-51.07
Ohio County	4.9	404,675,043		83/66,802	.232	-61.65
Union County	29.8	273,970,905	1,850,000*	39/82,447	.391	-35.37
Webster County	14.4	215,078,370	1,500,000	42/81,524	.267	-55.87
Providence Ind.	22.5	30,270,590	285,000	48/38,397	.537	-11.24

1 Derived by dividing local revenue per child in average daily attendance by assessed valuation per child in average daily attendance.

* after 1983-84.

Source: State Department of Education, Division of Research and Statistics.

Table 26

State Funds to Local School Districts

County/City	Minimum Foundation	Power Equalization	Fees and Textbooks	Total
Breckinridge	$3,067,056	$138,341	$ 31,573	$3,236,970
Cloverport	491,617	35,377	4,535	531,529
Daviess	9,069,971	243,316	109,296	9,422,583
Owensboro	5,960,386	230,888	67,434	6,258,708
Hancock	1,879,673	89,063	24,536	1,993,272
Henderson	7,681,292	391,079	126,361	8,198,732
Hopkins	8,347,478	364,446	145,416	8,857,340
Dawson Springs	871,310	64,894	15,898	952,102
McLean	2,151,620	115,673	6,483	2,273,776
Meade	3,597,871	248,451	12,413	3,858,735
Muhlenberg	4,655,574	184,224	87,060	4,926,858
Central City	872,776	78,709	16,478	967,963
Greenville	912,990	35,023	15,050	963,063
Ohio	4,469,552	243,328	56,454	4,769,334
Union	3,127,382	166,560	10,085	3,304,027
Webster	2,364,354	131,022	10,572	2,505,948
Providence	777,757	72,829	2,456	853,042

Source: Kentucky Department of Education, Division of Finance.

Table 27

County and City Tax Rates

Taxing Jurisdiction	1980 Total Tax Rate in Cents per $100 of assessed value	
	City	County
Breckinridge County		17.5
Cloverport (5)[1]	33.0	
Hardinsburg (5)	33.0	
Irvington (5)	50.0	
Daviess County		13.3
Owensboro (2)	36.0	
Whitesville (6)	25.0	
Hancock County		12.2
Hawesville (5)	41.3	
Lewisport (5)	24.2	
Henderson County[2]		9.5
Corydon (5)	17.0	
Henderson (3)	39.4	
Hopkins County[2]		12.3
Dawson Springs (4)	21.5	
Earlington (4)	27.5	
Hanson (6)	15.9	
Madisonville (4)	16.2	
Mortons Gap (5)	16.5	
Nebo (6)	14.0	
Nortonville (5)	25.3	
Saint Charles (6)	50.0	
White Plains (6)	17.5	
McLean County[2]		15.1
Calhoun (5)	18.0	
Island (6)	18.6	
Livermore (5)	18.1	
Sacramento (6)	23.3	
Meade County		15.6
Brandenburg (5)	33.3	
Ekron (6)	14.0	
Muldraugh (5)	15.3	

Muhlenberg County[2]		11.7
Bremen (6)	None	
Central City (4)	22.0	
Drakesboro (5)	33.9	
Greenville (4)	21.9	
Powderly (6)	8.4	
So. Carrolton (6)	None	
Ohio County[2]		11.0
Beaver Dam (4)	22.0	
Centertown (6)	NA	
Fordsville (6)	19.0	
Hartford (5)	23.0	
Rockport (6)	8.0	
Union County		15.3
Morganfield (4)	54.0	
Sturgis (4)	38.0	
Uniontown (5)	40.4	
Webster County		17.0
Clay (5)	24.3	
Dixon (6)	23.0	
Providence (4)	50.0	
Sebree (5)	33.0	
Slaughters (6)	35.0	
Wheatcroft (6)	10.0	

1 number in parenthesis is class of city.

2 these counties also have watershed districts for which a tax is levied but they are not countywide

3 county rates may not exceed $0.50; cities with population less than 10,000 $0.75; 15,000 or more $1.50.

Source: *Kentucky Property Tax Rates, 1980,* Kentucky Department of Revenue.

Table 28

Current County Bonding Capacity

County	Maximum Bonding Capacity	Current Indebtedness	Balance Bonding Capacity*
Breckinridge	$ 4,201,329	$ 236,000	$ 3,965,329
Daviess	25,262,298	0	25,262,298
Hancock	2,508,595	0	2,508,595
Henderson	14,182,492	190,000	13,992,492
Hopkins	14,049,506	0	14,049,506
McLean	3,223,679	46,000	3,177,679
Meade	3,453,880	0	3,454,880
Muhlenberg	10,189,781	0	10,189,781
Ohio	5,598,710	0	5,598,710
Union	4,888,630	0	4,888,630
Webster	4,165,825	0	4,165,825

Source: *Kentucky Department of Finance, State - Local Finance Office.*

*refers to General Obligation Bonds

Table 29

Projected Allocations FY 82
Local Government Economic Assistance Fund*

County/City	Mineral Producing	Coal Producing	Total Taxes
Breckinridge	$ 5,326	$54,772	$ 60,099
Cloverport	180	1,853	2,033
Hardinsburg	251	2,585	2,836
Irvington	160	1,647	1,807
County Total	**5,918**	**60,858**	**66,776**
Daviess	329,364	234,631	563,995
Owensboro	36,073	25,698	61,772
Whitesville	522	371	893
County Total	**365,960**	**206,701**	**626,662**
Hancock	55,929	34,734	90,663
Hawesville	2,229	1,384	3,613
Lewisport	3,985	2,474	6,460
County Total	**62,144**	**38,593**	**100,737**
Henderson	580,604	120,114	700,718
Corydon	2,193	453	2,646
Henderson	62,318	12,892	75,210
County Total	**645,115**	**113,460**	**778,575**
Hopkins	213,065	563,362	776,428
Dawson Springs	2,890	7,643	10,534
Earlington	1,775	4,693	6,468
Hanson	428	1,131	1,560
Madisonville	14,987	39,627	54,615
Mortons Gap	1,060	2,803	3,863
Nebo	237	627	865
Nortonville	1,179	3,118	4,297
Saint Charles	357	945	1,302
White Plains	758	2,004	2,763
County Total	**236,739**	**625,958**	**862,698**
McLean	245,913	52,263	298,176
Calhoun	7,366	1,565	8,932
Island	3,352	712	4,064
Rivermore	13,032	2,769	15,802
Sacramento	3,572	759	4,332
County Total	**273,236**	**58,070**	**331,307**
Meade	33,735	11,314	45,049
Brandenburg	1,795	602	2,397
Ekron	234	78	313
Muldraugh	1,718	576	2,294
County Total	**37,483**	**12,571****	**50,055**

Muhlenberg	494,489	643,801	1,138,291
Brenen	824	1,073	1,897
Central City	24,008	31,258	55,267
Drakesboro	3,674	4,784	8,458
Greenville	21,324	27,763	49,087
Powderly	3,904	5,083	8,988
So. Carrolton	1,206	1,570	2,777
County Total	**549,433**	**713,334**	**1,264,768**
Ohio	145,594	482,297	627,892
Beaver Dam	6,594	21,845	28,440
Centertown	956	3,168	4,125
Fordsville	1,161	3,847	5,009
Hartford	5,201	17,229	22,430
McHenry	1,205	3,991	5,196
Rockport	1,058	3,504	4,562
County Total	**161,772**	**535,886**	**697,658**
Union	540,476	558,659	1,099,135
Caseyville	334	345	679
Morganfield	29,392	30,381	59,774
Sturgis	17,864	18,465	36,329
Uniontown	9,087	9,393	18,480
Waverly	3,373	3,487	6,891
County Total	**600,529**	**620,732**	**1,221,261**
Webster	230,821	368,887	599,709
Clay	4,123	6,590	10,714
Dixon	1,620	2,590	4,211
Providence	13,484	21,550	35,035
Sebree	4,610	7,368	11,978
Slaughtersville	818	1,307	2,125
Wheatcroft	988	1,579	2,568
County Total	**256,467**	**409,875**	**666,343**

*cents dropped, no rounding
**coal impact, not coal-producing funds

Source: Kentucky Department of Finance, Division of County and Municipal Accounting.

Table 30

Population Changes Projected by County
First Synfuels/Power Plant Projection

County	Pop. 1980	Pop. 4th qtr. 1984	Annual Rate 80-84	% Change 80-84	Pop. 4th qtr. 1986	Annual Rate 80-86	% Change 80-86	Pop. 4th qtr. 1989	Annual Rate 80-89	% Change 86-89
Breckinridge	16,861	18,594	2.4%	10%	20,432	3.2%	21%	18,391	1%	- 9%
Daviess	85,949	93,673	2.2%	9%	101,372	2.8%	18%	93,741	1%	- 7%
Hancock	7,742	9,252	4.3%	18%	11,046	5.9%	43%	8,443	1%	-23%
Henderson	40,849	46,443	3.2%	14%	52,356	4%	28%	45,792	1.2%	-13%
Hopkins	46,174	49,928	2%	8%	51,882	1.9%	12%	53,789	1.7%	3%
McLean	10,090	11,498	3.3%	13%	12,712	3.9%	26%	11,865	1.8%	- 6%
Meade	22,854	24,714	2%	8%	25,791	2%	13%	26,368	1.6%	2%
Muhlenberg	32,238	33,458	1%	4%	34,320	1%	6%	34,076	1%	- 1%
Ohio	21,765	24,055	2.5%	10%	25,916	2.9%	19%	24,977	1.5%	- 4%
Union	17,821	18,924	1.5%	6%	19,853	1.8%	11%	19,495	1%	- 2%
Webster	14,832	16,137	2.1%	9%	17,294	2.6%	17%	16,542	1.2%	- 4%

Note: The annual rate of growth indicates that the projected changes are manageable for the region. However, over the 2-year period 1984-86, Hancock County is estimated to have a 19% growth (largely the additional effect of the proposed K.U. plant); Henderson, 12% growth; Breckinridge and McLean 10% growth; and Daviess, 8%. The bulk of the change occurs from 4th quarter of 1985 through the 2nd quarter of 1986.

Source: Quarterly Population Projections by Age and Sex for the Synfuel Power Plant Region of Western Kentucky: Research Projection No. 1, July, 1981, University of Louisville, Urban Studies Center.

Table 31

Prime Farmland Potential for Surface Mining

County	Prime Farmland (acres)	Coal Reserves[1] Level to Sloping Land[2] (acres)	Coal Reserves[1] Total (acres)
Butler	71,639	1,600	19,300
Christian	205,350	300	900
✓ Daviess	168,070	8,000	13,100
Edmonson	38,600	900	17,700
Grayson	96,300	5,900	21,700
Hancock	42,500	200	2,000
Hart	50,900	25	250
Henderson	186,100	960	9,600
Hopkins	157,500	28,000	40,000
McLean	114,700	2,200	2,600
Muhlenberg	89,700	33,300	80,000
Ohio	133,400	8,900	48,300
Warren	123,700	200	900
Webster	124,700		5,050
TOTAL	**1,603,159**	**90,285**	**258,450**

[1] Coal reserves having potential for surface mining (prominent coal seams with less than 150 feet overburden). Data used in preparation of Report for Green River Basin - Kentucky - Tennessee: USDA; SCS, FS, ERS; 1975.

[2] Slope of land surface is less than 12 percent. Most is suitable for cropland and includes prime farmland which has less than 6% slope.

Source: Estimated Crop Yields on Prime Farmland Soils in Western Kentucky Coalfields, July 1980, U.S. Soil Conservation Service, Lexington, KY.

Table 32

Surface Mineable Resources of the Western Kentucky Coal Field

County	Original Resources[1]	Total Production[2]	Total Depleted[3]	Remaining Resources
Breckinridge	10,000	-	-	-
Butler	115,668,000	7,965,196	9,956,495	105,711,505
Caldwell	28,242,000	430,386	53,798	28,188,202
Christian	61,728,000	2,149,446	2,686,808	59,041,192
Crittenden	18,178,000	63,935	79,919	18,098,081
Daviess	291.57	340.98	166.81	177.38
Edmonson	101,027,000	728,652	910,815	100,116,185
Grayson	90,642,000	849,092	1,061,365	89,580,635
Hancock	25,617,000	1,714,080	2,142,600	23,474,400
Henderson	144,621,000	-	-	144,621,000
Hopkins	1,207,689,000	183,365,242	229,206,553	978,482,447
McLean	126,970,000	6,941,628	8,667,035	118,292,965
Muhlenberg	1,377,898,000	343,889,636	429,862,045	948,035,955
Ohio	584,562,000	126,359,602	157,949,503	426,612,497
Union	129,970,000	2,028,212	2,535,265	127,434,735
Warren	4,094,000	32,470	40,588	4,053,412
Webster	226,539,000	19,177,936	23,972,420	202,566,580
TOTAL	**4,694,501,000**	**722,799,931**	**903,499,914**	**3,791,001,086**

1 Western Kentucky Coal Resources, Table 1, Kentucky Geological Survey, 1978.

2 Coal Production in Kentucky, 1780-1975, Kentucky Geological Survey and Annual Reports 1976-1979, Kentucky Department of Mines and Minerals.

3 A factor of 1.25 times the surface mine production.

Source: Staff Memorandum, Division of Research, Kentucky Commerce Cabinet.